ELECTRICAL REVIEW

[ILLUSTRATED.]

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Electric Firing of High Explosives.

DR. GEO. H. BENJAMIN.

All modern high explosives are now almost universally exploded, by the agency of electricity.

In fact, without the electric current, the uses to which such bodies can now be put, would be very greatly limited. The old-fashioned firing trains and fuses have long since almost entirely gone out of use, and with many of the more powerful explosives of to-day they would be of no use, as explosives such as dynamite, nitro-glycerine, nitro-gelatine and gun cotton do not explode upon ignition, but must be detonated, that is, submitted to a shock more or less intense depending upon the particular material which it is desired to explode.

The modern practice is to ignite detonating powder or fulminate by an electric current transmitted through a portion of platinum wire imbedded in detonating powder or fulminate. The detonation of the material in the fuse is transmitted to the explosive, and its full effect is realized. That is to say the explosive agent is immediately transformed from a solid (gun-cotton, nitro-gelatine) semi-solid (dynamite) or liquid (nitro-glycerine) into a gas, the amount of and rapidity with which the gas is generated, determining the explosive quality of the material. Explosives may likewise be divided into two classes: shattering compounds, *i. e.*, those mentioned in which the generation of gas is instantaneous, and rending or shattering compounds, such as black powder in which the evolution of gas is more gradual. Fig. 1 shows in section the construction of an electric fuse as commonly employed. *A* indicating a brass shell crimped around a plug *F* of sulphur in its base. *B* the detonating compound, composed mainly of fulminate of mercury. *C* insulated leading-in wires, form the source of electric energy. These wires are bare on the ends *D*, and to which is soldered, the platinum bridge *E*, adapted to be incandesced by the passage of an electric current.

Fuses have likewise been constructed for use with static currents, in which case the platinum bridge is broken and the ends slightly separated. On the passage of the current the spark leaps across the gap, igniting the fulminate in its passage.

Such fuses are now but little used, for the reason that they are dangerous. In firing a number of charges one may fail to explode, and such failure not be noticed, and subsequently exploded by the blow of a tool. Again experiment has demonstrated that high potential currents set up in contiguous wires (often as far off as fifty feet) will induce sufficient current to fire the charges of an independent series. Such fuses are considered very dangerous and unreliable. In the bridge fuse no such failure can occur, for if the bridge be broken no current can pass, and with all the fuses in order, no current likely to be induced will be sufficient in quantity to incandesce the platinum bridge wires.

When electricity was first used for firing explosives, voltaic batteries and frictional machines were universally employed. All sorts and kinds of batteries have been used, but none have been found so reliable as the chloride of silver battery of De la Rue.

Batteries, however, are troublesome to handle, and are almost invariably out of order when you most need them. Again where a number of charges are to be fired, and the resistance of the fuses in series high, it is, of course, necessary to connect up a number of cells in order to obtain the required current. As before stated, such batteries are troublesome to keep in order, and where portability and reliability is an essential are out of the question. Storage batteries seem eminently fitted for such purpose, but they will not stay in order without very careful and intelligent attention.

Frictional machines have gone out of use

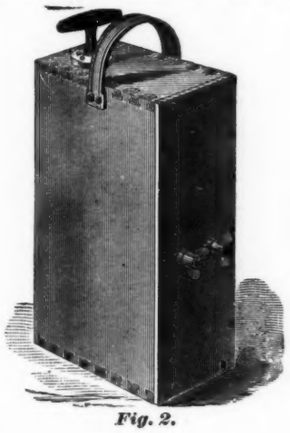


Fig. 2.

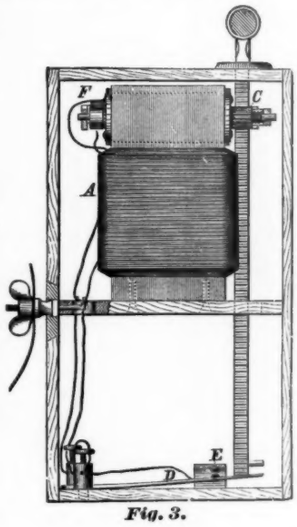


Fig. 3.

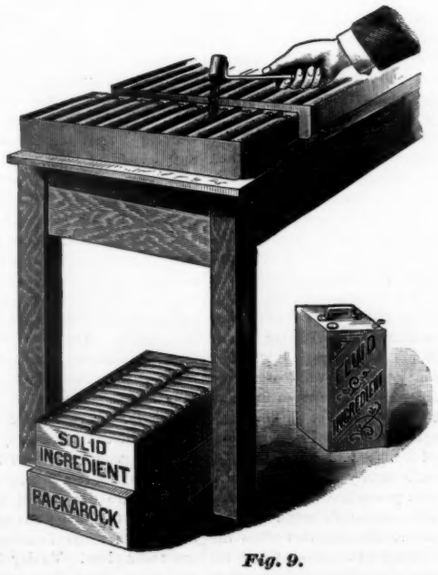


Fig. 9.

for the reason stated, and likewise because they could not be depended on in damp weather.

At the present date small dynamo-electric machines are used for furnishing the required currents. Dynamo machines were made years ago by Moses Farmer, Gramme, and others, but in every instance they were clumsy or unsafe to handle.

Figs. 2, 3 and 4 represent respectively an elevation, a side and end view of a very compact and satisfactory little machine made by the Rand Drill Company of New York. *A* represents the field magnets, and *B* an armature of the Siemens type, *C* a loose pinion on the armature shaft, which gears with the teeth of a vertically acting rack-bar *G*. The pinion *C* is toothed on its inner side, and is adapted to engage with a toothed collar on, and fastened to the armature shaft, being held in opposition therewith by a helical spring.

The rack-bar is shown in its lowest position, its end pressing against a flat spring *D* provided with a platinum contact point, which normally presses against a similar contact point *E*. When the rack-bar is drawn up, the circuit is closed through the field magnets and the external circuit. When the rack-bar is depressed the armature is rotated and the greater part of the current generated is used to excite the magnets, the resistance by this path being much smaller than that of the external circuit. When the bar strikes the spring *D* the short circuit around the magnets is opened, and all the current from the commutator *F* traverses the magnets, and external circuit; sufficient

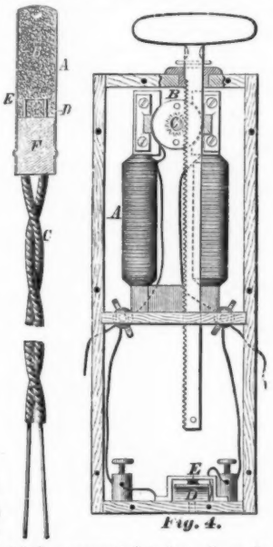


Fig. 1. *Fig. 4.*

current being generated to incandesce from sixteen to twenty fuses in circuit. The loose pinion on the armature shaft when the rack-bar is raised slips over the fixed collar on the shaft, and the armature is not rotated.

Figs. 5, 6, 7 and 8 show the application of electric and powder fuses to explosive cartridges, Figs. 6 and 7 the perforating fuse rods, forced down into the cartridges, for the purpose of making openings in which to insert the exploders, as shown in Figs. 5 and 8.

The particular explosive cartridges shown in the cuts are manufactured by the Rackarock Powder Company (Rand Drill Company, of New York), and consist of a solid ingredient and a fluid ingredient. The dry cartridges are saturated with the fluid before using, in the manner shown in Fig 9. The cartridges are placed in trough-like boxes, and the liquid poured over them. The combination of the two materials, each perfectly harmless when alone, makes one of the most powerful explosives known, and which possesses the very great advantage over all others that it is safe to ship and handle, and can be stored for any length of time, without injury or deterioration. The great explosion at Flood Rock was accomplished mainly by the use of this material.

The application of electric fuses to all classes of explosives is making rapid strides. Modern warfare demands the employment of such agents. Both in this country and throughout Europe much attention is being devoted to the subject, and there is undoubt-

edly a wide field for the application of inventive talent, both in devising and improving the many devices required.

Practical Notes Concerning the Construction, Use and Management of Storage Batteries.

By A. Reckenzaun.

There are at the present moment indications which tend to give one the idea that the manufacture of storage batteries is fast developing into a great industry, and if the existing rate of advance is maintained, we may expect that this new industry will soon become one of national importance. England is now the only country in which secondary batteries are produced on a sound commercial basis, and the progress which has been made is in a great measure due to large pecuniary sacrifices during the early stage of development. By small and apparently insignificant steps, and with great efforts and much unnecessary labor, have these batteries been brought to a certain state of perfection, and there can be no doubt that further improvements will yet be brought about; but such improvements will be sought in the direction of increased durability and reduction in cost of manufacture.

The premature confidence reposed in secondary batteries was long ago destroyed by early failures. Successes during the last two years, however, have had the effect of partially re-establishing confidence, and we may regard it as a happy incident that a reaction did not set in suddenly, for in that case there would have been a rush for the article, and in the attempt to satisfy too great a demand, without the requisite means of supply, inferior articles would probably have found a market.

How far the storage battery has re-established itself in public favor may be gathered from the fact that some £60,000 worth of storage batteries have been legitimately ordered and sold during the past twelve months. This represents in the aggregate about 1,000 tons of cells; this amount has been furnished by two or three firms in this country; we take no account of the tons of storage batteries which have not an established reputation, but which may have found purchasers, and others that may still pine in "purgatory."

The importance and desirability of an economical and practical secondary battery has been fully recognized by all who have considered the subject, and it is generally accepted that though there is a considerable amount of loss in the conversion of energy, the undeniable convenience of a method of electrical storage greatly compensates for the attendant waste. Besides the loss of energy there are two other objections to the employment of storage batteries, and these are first cost and depreciation. How far these objections may be justified, how far they have been removed, and in what direction they may be still further eliminated, will be the theme of these notes.

Loss of Energy.—It was generally assumed, in times when dynamo machines gave an efficiency of only 70 per cent., that the losses between the shaft of the prime mover and the terminals of the battery amounted to about 50 per cent. of the available power; modern dynamos, however, have an efficiency of 85, and some even 90 per cent. But in the application of the accumulator as an auxiliary to an installation, we have neither to blame nor to credit the cells with the goodness or the defects of the dynamo; and makers of dynamos would at once inform us that the secondary battery has to stand on its own merits. The efficiency, therefore, of the storage apparatus is a fraction of the total energy supplied to it by the electric generator, and this fraction amounts to not less than $\frac{7}{10}$ of 70 per cent.; in other words, for every 100 watts sent through the cells, 70 watts at least reappear as useful work.

Let us express this loss in terms of pence or a fraction thereof, assuming the source of energy to be coal at 20s. a ton converted into mechanical energy through a steam boiler and engine, consuming fuel at the rate of 5 lbs. per horse-power per hour. In round numbers, the cost of coal will come to one halfpenny, and since the steam horse-power has been found to yield sufficient energy through the medium of a dynamo to keep eight lamps of 20 candle-power incandescent, the light per lamp hour, as far as coal is concerned, will cost one-sixteenth of a penny.

Through the intervention of the storage battery then the cost per lamp per hour, in fuel, is raised to nearly one-eleventh of a penny. There is, of course, also more water used, and a greater wear and tear of machinery if the plant is working 10 hours for charging, and the accumulators alone are to supply light during seven hours without the engine. It is, however, seldom arranged that the engine is to stand idle whilst the maximum number of lights is required, and when the charging machinery is working in conjunction with the accumulator, the latter serving principally as a regulator or safeguard, then only part of the current generated by the dynamo would pass into the cells and the loss will be less in proportion. Against the objection relating to waste of energy, we may yet place the fact, that, when only a few lamps, out of many, are required to be alight, as would frequently be the case in most installations, we need not work the engine and dynamo, the wear and tear of which, as well as cost of attendance, is practically the same whether five lamps are in use or as many hundred. Moreover, if the consumption of fuel constituted the major part of the cost of electric lighting, then with the above figures before us we may still stay to consider whether it would be wise to adopt the storage system, but we know that the cost of coal in large installations is less, and in medium sized and small installations much less than one-half of the total outlay, hence the apparently big waste of 30 per cent. of the available power will appear small in comparison with the sum of items involved in electric lighting, when on an average we may take the value of a lamp hour at one half-penny, or between five and six times the cost of the fuel at the comparatively extravagant rate of 5 lbs. per hors power hour and 20s. the ton.

The foregoing is merely an example of a case where steam power has to be expressly put down for the purpose of electric lighting, but there are numerous instances when the advantages of storage batteries out-weigh the evil of waste entirely, where they come in not only as a great convenience but with absolute economy, always providing that their prime cost and maintenance are within reasonable bounds, which must and will be the case so long as the price of lead does not much exceed present rates and improvements in manufacturing processes continue to be effected. These favorable cases we may now proceed to consider.

First.—A case where the available source of power is small but continuous. There are thousands of factories, works, or mills using steam power throughout the day, and where a small increase of horse-power above the ordinary requirements will hardly be appreciated, and where the hours of darkness even in winter do not exceed three or four per day. There a dynamo may run off the common shafting all day with hardly any attention, and accumulate quie ly in secondary batteries the energy requisite for lighting the shops in the evening or early in the morning. Again, there may be a small steam engine, gas engine, or a small water wheel or turbine running continuously for 12 or even more hours a day, the power of which might be inadequate to give light to a given number of lamps by direct application, but energy might be accumulated during the many hours when not otherwise wanted; this would virtually amount to double or treble the power of the source for the few hours when used for lighting or other purposes.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Secondly.—A case, local circumstances being favorable, of even greater importance than the first, where power from a natural source would be entirely running to waste, where in consequence we should have a decided gain even were the efficiency of the apparatus not more than 20 or 30 per cent., instead of actually 70 per cent. This is the case with rapidly-flowing rivers and waterfalls in the vicinity of towns, industrial centers or residences. In the United States some 14,000 horse power are taken from waterfalls which formerly ran to waste, but now furnish the best of all illuminations, and on the continent of Europe also water-power is similarly largely applied, but in none of these advantageous situations are as yet storage batteries used, although they might treble the capacity of the plant. This is principally because the improved batteries are not sufficiently known, and partly because they are still looked upon as being too expensive.

Thirdly.—A case where the stored energy is to be utilized when away and disconnected from the generator. Electric cars and electric boats illustrate this case.

These are old stories dished up afresh; when first told, five years ago, they were mere theories, exercises of enthusiasm; to-day they are realizations. To-day by this repetition we record facts. This makes all the difference.

* * A new electric motor is being tested for the New York elevated railways. It weighs only a ton, while the locomotives now in use weigh twenty tons.

On the Transmission of Power—A Reply to M. Deprez.

M. Deprez has presented some observations on the note of October 26th. These observations, which tend to demonstrate that our experiments present no novelty, either in the methods employed or in the result obtained may thus be summed up:

1. The process of connecting machines is not novel.

2. The means employed for conducting the rings of the generators much resembles that patented by M. Deprez, April 28th, 1885.

3. Our machines turn too quickly.

Our replies shall be categorical.

1. The method of connecting machines is evidently public property. If MM. Gramme and D'Ivernois patented it in 1872, it was merely that they might not be prevented from using it.

2. The method which we employed for moving the rings of the generators is identically the same as that employed by MM. Chrétien and Félix in their installation for electric ploughing at Sermaize.

3. It is easy to show that there is nothing exaggerated in the speed of our machines, since there now exist more than a thousand Gramme machines which have been working at the same speed for upwards of ten years without requiring repairs.

What characterizes our recent experiments is not the novelty of the appliances: it is the use of simple dynamos and of well-arranged mechanical elements forming a whole not cumbersome, economic to establish, easy to manage, and, in a word, practical.

The result only appears novel—the transmission of 50 horse-power through a resistance of 100 ohms, with a yield of 52 per cent., whilst employing dynamos which together weigh only 8,400 kilos, and cost only 16,450 francs.

If it is true that in industry we employ by preference a machine of 100 horse-power, working slowly, in place of four 25 horse-power machines, working rapidly, it is especially to secure an economy in fuel.—*Comptes Rendus.*

* * In 1882 a representative from a New-England district received a request from one of those nuisance constituents who are always writing for books, that he would send a copy of the collection of patents on electricity, gotten up at the Patent Office. As the representative felt that he should want every vote the next fall that he could get, he stepped in at the Patent Office and asked if he could get a copy of the collection. He was told that he could, but only by paying the cost price, a few extra copies having been prepared. Supposing that it would be half or three-quarters of a dollar, the representative pulled out a one-dollar bill, and asked what the price was. To his horror the reply was, $454.79. He did not buy the collection. This collection was made by order of the Commissioner of Patents to send to the International Electrical Congress. There were 3,825 patents appertaining to or bearing upon electricity granted prior to July 1, 1881, all reprinted in uniform style, and the drawings reproduced by photo-lithography. They were arranged in sixty-nine sub-classes, and bound in sixteen quarto volumes of about 2,000 pages each. A few additional copies were printed and bound for sale, but Congressmen could not be expected to give away many of them.

* * In the new organ now being built by Messrs. Willis for Canterbury Cathedral, the electric current is also employed as a transmitter of power from the fingers of the organist to the pipes, which will be 120 feet above him. This is no new application of electricity, for the same thing has been done in past years. But the system employed is new, and is the invention of the builders of the organ.

*** A. G. Day, the kerite wire and cable manufacturer, has engaged the services of Mr. Ralph W. Pope, We do not know of any one in the electrical field who is better known than Mr. Pope, and a gentleman of such popularity will be of great aid on staff of Mr. Hotchkiss, the efficient and able representative of Mr. Day.

The Thomas Automatic Lubricators.

This new style of lubricator, shown in cuts herewith, seems to be specially adapted for use on high speed machinery such as used in electric light plants.

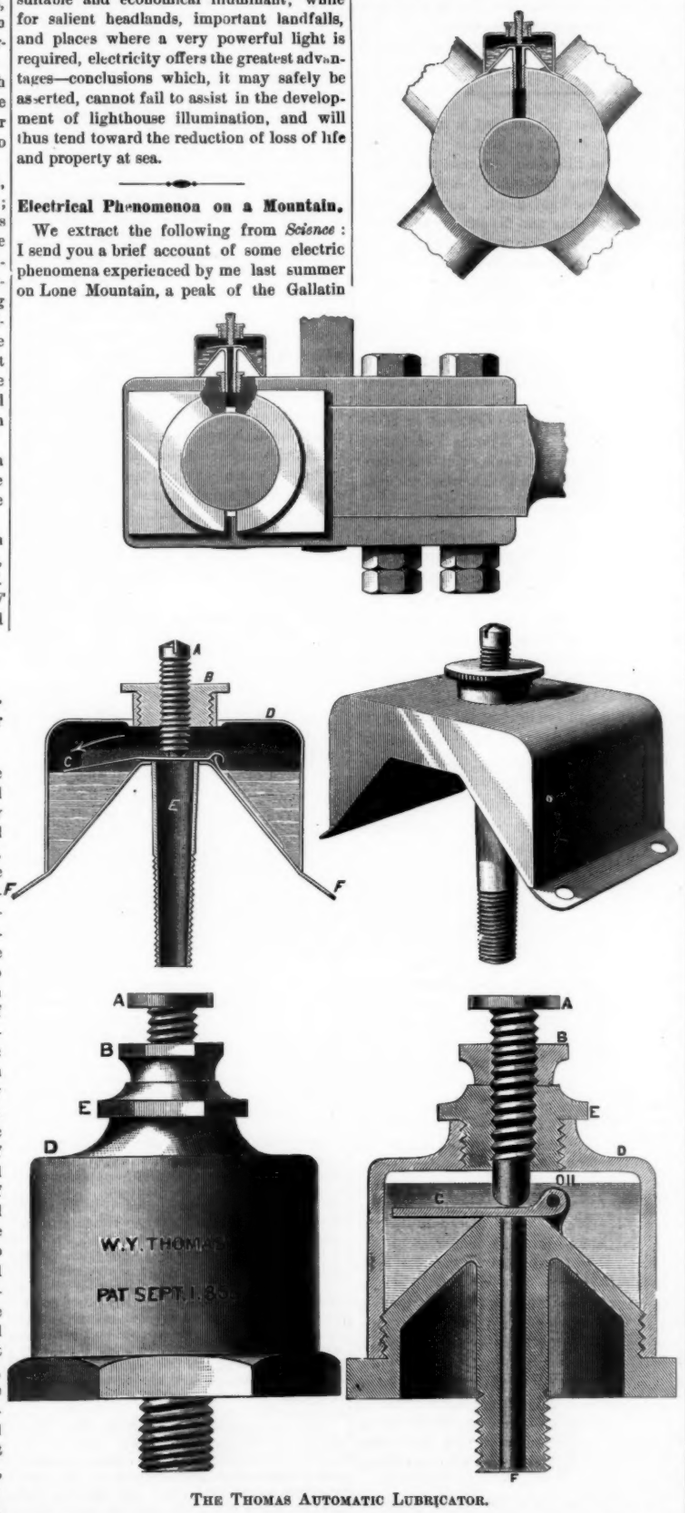
The main principle of this device is economy in use of oils, at the same time doing its work so thoroughly that a perfectly lubricated and frictionless journal bearing is obtained. The usual dripping and waste of oils, the loss of time and money consequent upon the stopping of machinery for oiling purposes is hereby entirely done away with.

Within the casing is a deflector *C*, which consists of a plate hinged at one end to the bottom of the casing and located above or overhanging the top of the tube, so as to open and close the same.

The deflector is adjusted by a screw *A*, which is inserted in the cap *B* of the casing; it will be seen that when the pulley rotates in the direction of the arrow, the oil in the chamber of the left side is directed by centrifugal action against the free end of the deflector *C*, thus lifting the same and opening the top of the tube, so that the oil is positively directed into the tube and passed to the journal to be lubricated. It will be seen that the feed of the oil may be regulated with the greatest nicety, and the tendency of the oil to be driven by centrifugal force away from the tube is prevented by the deflector *C*.

As the bottom of the casing is raised from each side to the center, two chambers are formed so that a large supply of oil may be provided in the casing.

To fasten the oiler—should the oil hole in the pulley be larger than the tube of the oiler, a piece of wood should be screwed to tube *E*. Wire is inserted in the eyelets of the oiler *F* and wound round the hub of pulley and twisted there, fastening the oiler securely.



THE THOMAS AUTOMATIC LUBRICATOR.

Unquestionable Proof as to the Vast Superiority of the Electric Light for Lighthouse Purposes.

In 1881 it was considered by the lighthouse authorities of Great Britain that the time had arrived when it was absolutely necessary that an exhaustive series of experimental trials should be made, on a practical scale, for the exact determination of the relative merits (both as regards efficiency and economy) of the three lighthouse illuminants—electricity, gas, and mineral oil. This question was, in July, 1883, referred by the Board of Trade to the Trinity House, who accepted the responsibility of carrying on the investigation, and formed a committee of members who secured the friendly co-operation of the Scotch and Irish Lighthouse Boards, and of many distinguished men in Great Britain and elsewhere. The Trinity House Committee courted the fullest inquiry. All their arrangements were open to public inspection. Many engineering members of scientific societies visited the station, and officers from the lighthouse services of France, Germany, Denmark, Norway and Sweden, Russia, Italy, Spain, Brazil, the United States, and Canada were present to witness the experiments. During a period of more than twelve months the experimental lights were on exhibition, and were watched by numerous observers, trained and untrained, scientific and practical, and a vast amount of valuable evidence was collected, by the aid of which the Committee were subsequently enabled to state their conclusions with definiteness. It was demonstrated that the electric arc had the most important requisites of a lighthouse luminary, viz., maximum intensity and minimum focal dimension; and, in all states of atmosphere, from clear weather to thick fog, the incontestable superiority over the utmost efforts of its rivals, gas and mineral oil. With the best gas and oil luminaries as employed in haze and fog, when maximum intensity only is required, the question of merit resolved itself into one of pure economy, and mineral oil at the present market prices was found to have a considerable advantage. The relative penetrability per unit of light of the best gas and oil luminaries in haze and fog was found to be practically identical. In certain conditions of thickened atmosphere the electric arc light appears at some disadvantage, being absorbed more largely by haze and fog than either the oil or gas light, while all three are nearly equally affected by rain. The final conclusion of the Committee on the relative merits of electricity, gas, and oil as lighthouse illuminants is, that for ordinary lighthouse purposes, mineral oil is the most suitable and economical illuminant; while for salient headlands, important landfalls, and places where a very powerful light is required, electricity offers the greatest advantages—conclusions which, it may safely be asserted, cannot fail to assist in the development of lighthouse illumination, and will thus tend toward the reduction of loss of life and property at sea.

Electrical Phenomenon on a Mountain.

We extract the following from *Science*: I send you a brief account of some electric phenomena experienced by me last summer on Lone Mountain, a peak of the Gallatin range about thirty miles southwest of Bozeman, Montana.

In company with Mr. James Walsh, my assistant, I climbed this mountain on August 7, 1886, for the purpose of making it a topographic station of my work in that vicinity. It is about eleven thousand feet above sea-level, and higher than any other peak within a radius of at least twenty miles. It stands alone, being separated from the other high points of the range by low saddles. The mornings for two weeks previous had been bright and clear, but afternoon thunderstorms were of daily occurrence. The morning of August 7 was clear as usual; but about noon clouds had appeared in the west, and by 2 P. M. distant rumbles of thunder were heard, and dense black cloud-masses were sweeping towards us. About this time, as I was working at my plane-table, I heard a peculiar buzzing sound coming from the instrument, very much as if a large fly or wasp was imprisoned beneath one of the plane table sheets. Placing my hand on the table I received quite a severe shock, and starting back in surprise, felt another in my partly uplifted right arm Immediately after the rocks upon us began to hum and buzz in a peculiar manner, giving a sort of musical sound, and the hair of our heads, beards, and eyelashes to snap and crackle viciously. This phenomenon was felt with greater intensity in a small spot on the very tops of our heads, was accompanied by a tingling sensation, and at short intervals by slight shocks, which made us cringe involuntarily. On removing our hats, a tuft of hair stood upright over these spots. A shock was received whenever the hand came in contact with the head.

Placing the instruments in a horizontal position under cover, we descended the mountain about one hundred yards, to a point perhaps fifty feet below the summit, and lay down flat. While in this situation, no unpleasant feelings were experienced, although the rocks still continued their musical hum; but the shocks and tingling sensations were immediately felt on raising any portion of our bodies to an upright position. The thunder-storm, accompanied by hail and rain, soon burst upon us, and continued for half an hour, after which the peculiar electric condition of the atmosphere passed away.

We noticed during the storm that at least 80 per cent. of the lightning flashes passed between masses of clouds, and not between the clouds and earth, and that none of these flashes, as determined by the interval between sight and sound, were within a mile and a half of the peak we were on.

The summit of Lone Mountain is a loose mass of broken volcanic rock. There are no large boulders or projecting points of any kind. M. F.

* * A Paris correspondent of one of the daily journals says: "The chief French surgeons and medical professors have for some time been carefully studying the effects of mesmerism on the female patients of the Salpétrière Hospital, and M. Babinski, a clinical surgeon of that establishment, has just effected a series of experiments, the results of which would seem to open up a new future for medical science. M. Babinski tried to prove that certain hysterical symptoms could be transferred by the aid of the magnet from one patient to another. He took two subjects, one a dumb woman, afflicted with hysteria; and the other a female who was in a state of hypnotic trance. A screen was placed between the two, and the hysterical woman was then put under the influence of a strong magnet. After a few moments she was rendered dumb, while speech was suddenly restored to the other. M. Babinski also affected temporary cures of paralysis in the same manner." We would suggest to M. Babinski that he should repeat his experiments with pieces of wood or copper of the same size, shape, and color as his magnets, when we have not the least doubt that precisely the same measure of success would be attained. It is a great pity that the exploded fallacy of "curative magnetism," which so readily lends itself to the purposes of the charlatan and the quack, should receive the least countenance from any one claiming to be an authority in medicine. The employment of electricity in therapeutics stands upon a totally different basis, although its true function and limitations still remain to be worked out, and afford a most legitimate field for inquiry.

—— A rather curious state of affairs exists at Vienna with regard to the long-projected central electric lighting station in that city. Some time ago the municipal authorities placed their veto upon the scheme as it then stood. Now, however, according to *La Lumière Electrique*, the Minister of the Interior has granted authorization to the same parties to whom it had been refused by the municipality. We do not know whether the Ministerial decision absolutely overrides that of the municipal authorities, but the upshot seems to be that negotiations have been reopened between the latter and the authors of the scheme.

* * A mechanic in Louisville, Ky., thinks that he has invented an apparatus which will discourage the giving of false alarms of fire. His appliance is a pair of magnetic nippers, which grasp by the wrist the man who turns in an alarm and hold him at the box until the arrival of the fire department. The man who turns in the alarm can be released only by the firemen, who are supplied with keys which turn off the current, when the magnet relaxes its grip.

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The interference case on vibrator claim in the Edison-Gilliland patent vs. L. W. Phelps, was decided by examiner last week in favor of the former. This is important in railway telegraphy.

THE REVIEW wishes its innumerable friends a very merry Christmas and a happy New Year. The prospects are bright and promising in every field for the ensuing year.

Did you ever, while looking at an arc light plant, notice the effect all along the line, when one carbon failed to feed properly? How readily every light responds! It is as if everytime one of the lamps took snuff all of the sympathetic burners were bound to sneeze.

A Western editor asks, "What is it that everybody is rushing after?" That depends. If he is a policeman perhaps he is getting out of the way of a row, but if it is an electric light agent he is after making somebody believe his is the best—the only—the system.

The annual deluge of calendars is upon us. They come in most questionable shapes, and have as many forms and variable dimensions as clouds in a summer sky. One of these has a design by Beard the animal painter, which is both unique and original. The hollow tree, in which a family of bears have, until now, domiciled, struck by lightning, is fiercely burning. Mother bear, in a fainting condition is unconsciously squeezing the baby until one can almost hear its howls, and Father bear, supporting his fainting helpmate with one arm waves a policy of insurance in the air with the other, and says: "Don't cry, the old home has gone, but we are insured in the Continental."

Berlin has about 6,000 telephonic subscribers, with 12 public stations. The total installation cost something like two and one-half million francs.

Experiments upon thirty-three German railroads have satisfactorily demonstrated the feasibility of using the telephone upon moving trains, and especially where the traffic is not too crowded. On heavier lines the telephone has not proved sufficient for the purpose, and has been used as an auxiliary to the telegraph.

What different ways they have in Prussia from those in vogue in this part of the world! In Elberfeld, for example, there had been some talk of a necessity for a central electric light plant. After a proper amount of cussing and dis-cussing and smoking and beering by the people, the municipal council took the matter in hand and ordered an election. The ballots read: "For a public installation of city lighting by electricity," or words to that effect, and "Against," etc.

Of course, the electric light people were at the polls, and directly or indirectly assisted. The victory was complete. The enemies of reform and progress were captured as easily as were the troops of Jacobus Van Curlet, taken by the crafty Yankees at Fort Good Hope, in the good old Knickerbocker days.

In the oil fields of Southern Russia there is a spouting well which throws up a column of oil 224 feet in height, and gives a product of about 360,000 gallons an hour—more than all the wells in the United States, but much of the oil is lost owing to imperfect methods of handling. A lot of wells belonging to one company there are yielding 2,750,000 gallons per day. And yet the electric light people complain they have to burn the midnight gas to fill orders for dynamos and lamps for new plants.

ELECTRO THERAPEUTICS.

The father of a preccious youth bought the boy a battery, with attachments, such as is sold to youths—beg pardon—amateurs. Everybody was pressed into martyrdom of "taking shocks," with no serious results until the old sir called the boy's attention to the following item which the newspapers have been stealing from each other: A tamer of wild beasts in Paris carries a metal rod, the upper end of which is in connection with an electric battery, while the handle is insulated from the current. When he needs to subdue an angry beast, he simply touches him with this instrument, and the effect is immediate. The elephant is the only animal that can resist the current—and commended it as something practical to be applied to their dog who wouldn't mind, and to the cat who would steal. The dog was out making calls, but the cat was caught and given a saucer of milk which was placed in an iron pan, one conductor was immersed in the milk and another attached to the pan upon which pussy's fore legs were resting. As soon as puss was fairly started in the treat circuit was closed and with a yowl, a spit, and fizz generally, a bristling cat first jumped into the air, and on landing, struck the milk, knocking it over the carpet. The treatment was a success in the measure that it cured the cat of drinking milk, and rendered her as afraid of those present as if they were amateur Thomsonian physicians who had dosed her for fits.

The dog came home, he was a cross between Newfoundland and mastiff, with sundry ancestral vagaries suggestive of all the dogs in the neighborhood. He also was fed and shocked, so were the assembled family, as he snapped viciously at several before he caught the young man by the pantaloons and closed the circuit of his jaws, and leaping through a window abandoned their roof forever.

Thus the experiments were considered a success, thoroughly justifying the trouble, for it has revealed a method of disposing of a yellow dog.

FOREIGN CHECKS ON ENTERPRISE

Since the commencement of electrical development in the fields of telephony and lighting, America has been pushed farther and farther in advance of the old world. The best proof of this, after surveying the ground itself, is to be found in the tone of the foreign scientific and technical press. It is not so long ago that the foreign journals contained little or nothing of American scientific development. They confined themselves to printing an occasional paragraph, with a few ill-natured sneers as editorial comment, and cribbing a few columns here and there from American scientific journals, which they passed off as their own upon their deluded readers. Now, however, this is all changed. English, French and German scientific journals publish whole pages of news from America, and probably credit most of the matter they borrow from American journals, not—we should like to say—because they have seen the error of their ways, and because of a determination to be honest, but rather for the reason that their patrons read the American papers so diligently that they would detect the old style of imposition, were it still practiced upon them.

The careful discrimination which characterizes the giving of "concessions" by the European governments has much to commend it, of course, because it makes less facile the struggle of the fraud and impostor to sell worthless stock, and to embark in a business of direct interest to the public without sufficient capital. But the system has, too, a bad side. It checks progress, and puts a heavy brake on enterprise; it demands of the projector that he guarantee as perfect a system which is scarcely out of its experimental stages, though of great public utility, and compels him to look into a future which even to those of longest and keenest sight is yet obscure.

As a result, the telephone and the electric light are scarcely used at all, if we consider the extent of their use on this side of the ocean.

In proof of this let us look at some figures compiled by Prof. Plympton, of the Brooklyn Subway Commission, who recently made an extended tour in Europe for the purpose of comparing the electric development of the two continents. He says:

"The problem of construction of a telephone system on such a scale as exists in American cities with underground wires has not yet been solved abroad. In Europe no attempt has been made to solve it, because as yet there is no such general use of the telephone. The number of telephones in the United Kingdom of Great Britain reported on January last was 13,000, while in the United States at the same date there were 327,000. There are more telephones in use in New York and Brooklyn than in all Great Britain, more in New York city alone than in all France. For the accomplishment of the ultimate object of converting our overhead electric systems of all kinds to underground systems, without impairing the efficiency of their service, without permanent injury to our streets, and without increasing the cost of the same, we must depend upon the experience gained and experiments made on our own side of the Atlantic.

Think of so great a country as Great Britain, whose capital is the money center of the world, whose combined capital is greater than the combined capital of any other country, and whose greatest strength is supposed to lie in its commercial enterprise and business acumen—think, we say, of such a country almost doing without the telephone! Is it because its citizens are not in need of the telephone? On the contrary, they are clamoring for it.

But governmental restrictions, monarchical red-tape stands in the way. Those who would project telephone lines must promise that certain accidents to which all such enterprises are subject, shall not happen, and are compelled to deposit certain large sums of money which, if the promise is not fulfilled, are forfeited to the government. To the ordinary mind it would seem that where such restrictions are laid upon the projector he should in like manner be rewarded if he succeeds, and that if the government are to receive a certain large sum of money if he fails to keep to his agreement, the government should pay over to him a similarly large sum if he faithfully performs his contract. But no; with the British projector as against his own government it is "heads I win, tails you lose," every time, and in France and Germany, and Italy, it is not much better.

CHICAGO ELECTRICAL NEWS.

Under St. Louis date of the 15th, a correspondent states that Judge Barclay in the Circuit Court rendered a decision in the suit of District Attorney Bliss against the Baltimore and Ohio Telegraph Company. That gentleman filed a dispatch with the Baltimore and Ohio Company to be forwarded to Chicago, appointing a meeting there. The suit was to recover for failure to forward and deliver the dispatch in proper time. The defense was based on the stipulations, regulations, cautions, conditions and things printed on the blanks—a mass of reading matter which no one reads or cares for except insomuch as it prevents the blank from being used for any other purpose than telegraphy:

"The company shall not be liable to mistakes or delays in the transmission or delivery or for the non-delivery of any unrepeated message, whether happening by the negligence of its servants or otherwise, beyond the amount received for sending the same."

The court says upon that point: "All that need be stated concerning such a stipulation is that in so far as it seems to exempt the telegraph company from the consequences of its own negligence, it is against public policy and entirely void and of no effect. There will therefore be a finding in favor of the plaintiff."

In the old days when people believed in incantations, witches, potions and spells, superstition got in its labors everywhere. But as a Christmas offer the party who can do better than the chap who had the spell herewith is entitled to one of Santa Klaus' best three f'rs on sight. It isn't exactly electrical, but it spits and sputters all the way through like "one of those nahsty spitting lamps."

We begin the publication of the *Roccay Mountain Cyclone* with some phew diphphiculties in the way. The type phounders phrom whom we bought our outphit phor this printing-ophphice phailed to supply us with any ephs or cays, and it will be phour or phive weex bephore we can get any. The mistaque was not phound out till a day or two ago. We have ordered the missing letters and will have to get along without them till they come. We don't lique the loox ov this variety ov spelling any better than our readers, but mistax will happen in the best regulated phamilies, and iph the ph's, and c's, and x's, and q's hold out we shall ceep (sound the c hard) the *Cyclone* whirling aphter a phashion till the sorts arrive. It is no joque to us—it's a serious aphphair.

Mr. J. H. Reid, general agent here for the Mather-Perkins system, is reaching out in a very successful manner, and "transacting" to a considerable extent in incandescent lighting. He recently captured the Hennepin Avenue Theatre at Minneapolis, which is to be ready for a grand electric opening on the 1st of February with 700 incandescent lights. The dynamo will have full capacity for 600 lights, but will never have its full complement running at any one time.

Mr. Reid has also closed a contract with the Oliver Wendell Holmes' Hospital, at Hudson, Wisconsin. The dynamo will feed 150 lights, but the building will be wired for 200 lamps.

The Mather-Perkins system has so well pleased the Cincinnati *Commercial-Gazette* people that they recently ordered a duplicate of their present plant. When completed the newspaper with the hyphenated name will have 600 glow lamps in daily service.

It has been said that the shoemaker's wife is always poorly shod, and the miller's wife is always scratching the bottom of the meal tub. In an electric light manufacturing establishment the other day—a cloudy day—every employe was using gas. Said one who was present: "Why don't you use electric light?" The answer was a curious one. "First our folks put in the arc lights, and we all kicked. The employes kicked harder every day till they took 'em out. The company put in the large incandescent fellows that look like little boys' heads in big boys' collars, and there was more kicking. They

put in the little incandescent lamps, and we all kicked again. We have finally kicked 'em out." This, too, in a town where one of the richest gas companies is running an electric light business, and manufacturing incandescent lamps on orders! Extremes do meet, don't they?

Caught down town after that time in the dark part of the twenty-four hours when honest people should be in bed and tramps locked out in the fresh air, the attention of the writer was called to the illuminated condition of the Western Electric Company's building. Inquiry as to the cause brought out the fact that the available force and machinery is incompetent to keep up with orders.

Recent orders in underground work includes three and one-quarter miles of Patterson cable for the United Lines Company here, to replace a piece of old B. & M. conduit cable, which has been submerged in all sorts of filth, mud and sewage in the south portion of the city for a long time. This cable comprises 20 wires.

Two and one quarter miles of seven-wire aerial cable for the Postal Company, which is going to San Francisco.

Four miles of 100-wire underground cable for the N. Y. & N. J. Telephone Company at Brooklyn.

The New England Telephone Company, Boston, has an order in for 2½ miles of 50, 80, and 100 wire underground, and the Missouri and Kansas people are hurrying and hungering for 2½ miles of aerial 100-wire cable; and 3,500 feet of 20-wire submarine telephone cable is ordered for San Diego, Cal.

Mr. Patterson has the switchboard department after him also with an order for 100 miles of 20-wire switchboard lead tape cable for New York, Boston, Albany, Syracuse, and Omaha

The Western Electric Company has on hand and in process of completion, orders for electric light commercial plants for Philadelphia and New York, apparatus for Norwalk, Ohio, where the plant is eventually to grow to 100 light capacity, Concordia, Kan., a 30 light plant to blaze out for the holidays. Junction City and Clay Centre have also increased their present plants.

Everyone is struggling to find something novel in the way of advertisements. A new feature, the invention of a Chicago firm, consists of a paper wallet with a few pages of memorandum paper, and printed matter to suit the occasion. The W. E. Co. will issue a lot of these to customers and favorites, with cuts of dynamo and lamp, accompanied by the usual amount of remarks on the excellence of the system; a calender that the electric light people may know when Sunday comes, and a moon table to control the lighting Now if Brother Brown would only add a rain table so the boys would know when to wear their rubber boots and rain coats, the thing would be complete. In addition to the above, the calendar craze has taken them. Outside the usual limited space into which the twelve months are crowded there are represented on the card, which is a beautiful piece of workmanship, of the neat, but not gaudy style, nearly everything manufactured under their spacious roof. Multiple switchboards, call bells, watch clocks and batteries, dynamos and cables, electric lights and annunciators, relays and magnetos, pony sounders and push buttons, box relays and a four story building 311 feet long.

That calendar is a reminder. Specimens of all electric light, wire, dynamo, or other electric manufacturer's calendars are wanted at this office to help make a collection. Send them to C. C. Haskins, Room 65, 118 La Salle street, Chicago.

CHICAGO, Dec. 20, 1886.

BOSTON ELECTRICAL NEWS.

For years the students of Harvard University have grumbled through the columns of the college press at the hours of closing the library This is situated in Gore Hall, not too well lighted on a bright day, and dark early on the cloudy days of winter. It is closed at 5 o'clock or earlier when there is not enough light. In the winter season the average time for closing is perhaps 4 o'clock P. M. The branch library in the law school is in a well-lighted room, and is open till 9 P. M. Gas is used in the law school building, but not in the library proper in Gore Hall. The fear of danger from fire is the cause. Ever since the demonstration of the practicability of incandescent lighting the question has been often asked why the library could not be lighted by electricity. There is now some talk of the proverbially slow corporation taking some steps in the matter. It would be desirable for the college to establish a small central station of its own in the basement of University Hall. This building, the library, Boylston Hall (chemical laboratory) Sever Hall, the Hemenway Gymnasium, Memorial Hall, Jefferson Physical Laboratory, would require about 400 sixteen candlepower lights. The college dormitories in the immediate vicinity would perhaps require 600 more, it being as natural for the college to collect money from the readings of meters for incandescent lighting as to collect gas bills for the Cambridge Gas Company.

The 24-hour clock in front of the store of A. Shuman & Co., 440 Washington street, has an additional feature now in the form of a time ball similar to the one on the top of the Post Office Building. It has been placed there by this enterprising firm, and is connected with the Cambridge Observatory, thus assuring correct time when the ball is dropped each day at high noon. The workings and dial of their 24-hour clock have been changed so that now one can readily tell the time according to the old system or the later 24-hour arrangement.

Not many years ago, the gas light companies were noted tor the amount of stock they took in conservatism. They carried the principle so far that they neglected the benefits resulting from a mutual exchange of ideas and notes on the management of their business. Each company thought they were far ahead of every other company, and so things went along until the electric light began to throw a little light on their darkness. All at once the meetings of gas engineers were mis-spent in reading papers on, "Pshaw! we don't care for the electric light." Chorus: "That's so." But they did. After some years of laborious argument, which might have scared away almost any other phenomenon of nature from this earth, it was found that money could be made in supplying electric current. Many corporations, manufacturing and supplying gas honestly, desired to extend their business, and so applied to the Legislatures of the various States for permission to change their charters. In Massachusetts, last spring, such permission was granted to a few companies who have not, and apparently do not intend to enter into the business of electric lighting.

An attempt to pass a general law last spring failed. Its passage would have enabled gas companies to enter at once, or at any time in the future, upon the electric light business. That an attempt will be made to pass such a law this winter, there is no doubt. In two towns where permission has been granted, it is simply impossible to form a local company to put in electric light. The gas companies having their charters so amended are ready at any moment to head off competition, by installing an electric plant themselves. It is openly boasted in gas journals that such is the plan for all companies to follow out. Now, is it desirable to give the gas companies a means whereby they can keep out electric lights? As the law now stands, there is nothing to prevent a formation of a separate company practically under the same management as the gas light company. If the privilege to amend charter is desired for the legitimate purpose of extending the range of business, and not to prevent the introduction of an improved mode of lighting, it should certainly be granted.

The station of the Newton Electric Light and Power Company, Horace B. Parker, president, is rapidly approaching completion. Ninety Thomson-Houston arc lights will be used at first. Watertown, as well as Newton Center, Newtonville, West Newton, Auburndale, Newton Lower Falls, will be supplied with light. The company will furnish power for the electrical railway for which a charter has been granted by the State Legislature. Long petitions from every part of Newton have been laid before the Board of Aldermen, who, it is said, will probably grant the location for the road. It is the present intention of the railway company to use some form of storage system.

W. L. Faxon, John C. Randall and C. A. Faxon, of Quincy, have filed with the Secretary of State a petition to the Legislature for incorporation for the purpose of building a street railway in Quincy, to be operated by a motive power other than steam. The proposed route will connect the villages of West Quincy and Quincy Point with the center, covering about five miles. New York parties are ready to build the line and take a large amount of stock. The line would eventually run through Wollaston and Atlantic to Neponset, connecting at Fields Corner with the Dorchester avenue road and thence to Boston.

Mr. John J. Moore, manager of the Springfield Electric Light Works, was tendered in September last a position with the Thomson-Houston Company of Boston, which he accepted and submitted his resignation at the time. It took effect December 1, and his going was the occasion for a very pleasant surprise Tuesday evening, when the employes gave him a handsome hammered silver tea service worth $75. Mr. Bowen, the assistant manager, voiced the feelings of the men in a neat presentation speech, and Mrs. H. S. Hyde gave a fine set of table linen as a fit accompaniment. Mr. Moore first entered the service of the company as bookkeeper in 1881, and in 1883 was given the management of the plant. It is no injustice to say that when he took hold the company had been losing money, the lights were unsatisfactory, and business men who tried them were ordering them out Mr. Moore was given the fullest liberty in management, and he is proud to see that today the plant and service stand among the first in New England, and the Thomson-Houston Company send to this city business men who wish to see their system in perfect working. An unsolicited letter from Mr. Brophy the chief inspector for the New England Insurance Exchange, says, after acknowledging that he came here prejudiced against the company's efficiency by outside reports, 'Your lights burn with unusual steadiness, and the dynamos show unusual care and attention. I am very much pleased and think the company ought to be." Mr. Brophy went over all the lines personally, and adds other praise in detail. It is Mr. Moore's successful efforts in this work that wins him his new position, wherein he will look after the Thomson-Houston Company's interests at various points—he was at Northampton this week and will be in Connecticut next week—but will continue to reside in Springfield for the present. Mr. Jerome Hyde, who is thoroughly posted in the work, succeeds him as manager. The Springfield Company, by the way, is doing quite well, and its original capacity of 50 lights is increased to a system of 250 arc lights and 400 incandescents, with 20 horse-power in motors.

BOSTON, Dec. 22, 1886.

The smaller the distances between the surfaces and the greater the area of the surface of the Leyden jar the greater its capacity.

The temperature of a furnace may be determined approximately by means of an observation of the resistance to a current of electricity of a platinum wire placed in the furnace.

ELECTRICAL QUERIES AND ANSWERS.

Editors Electrical Review:

Ought I to amalgamate the zincs of a Leclanche battery? AKRON.

ANSWER: With pure zinc and pure sal ammoniac there is no necessity for amalgamation. It will do no harm, however, and in case your materials are not quite pure you will find it an advantage.

Editors Electrical Review:

Can I use arc light carbons in a Bunsen battery? M. M.

ANSWER: Yes, make a good connection by winding copper wire say 10 turns around one end and soak in hot paraffine.

While copper has the greatest conductivity or smallest resistance of any metal, for a given volume, aluminum has the smallest resistance for any length of given weight.

Copper terminals are easily amalgamated by dipping them in a solution of mercurous nitrate. This latter may be made by dissolving a drop of mercury in nitric acid.

Editors Electrical Review:

1. What is the difference between alternating and constant current dynamos? 2. I should think that an ordinary ammeter would not give accurate measure of an alternating current. 3. How can I make a model of a transformer?

Answer: An alternating current is one which changes its direction, going first in one direction, then in the opposite, again in the first, etc., etc. The changes or alternations can be caused to be of any number according to the speed of the machine and number of coils on the armature of the dynamo. In an induction coil, the number of reversals is equal to the number of vibrations of the circuit breaker of the primary circuit. 2. Instruments for measurement in common use are not suitable for measuring alternating currents. 3. Make a ring about 5 in. diameter, 30 turns of No. 18 insulated wire, winding wires togther, one for the primary, the other for the secondary circuit. In fact, you will have two coils each having two ends; cover this double coil with silk ribbon. Next wind the ring with one pound of fine iron wire about No. 22. To do this first wind the wire on spools, and wind the wire on the coils by passing the spool over the coil through the center of the ring and under the coil, continuing until the iron wire is used up.

Editors Electrical Review:

What is the difference between a Grove and a Bunsen battery?

Answer: In the Grove for the negative pole a strip of platinum in nitric acid is employed. In the Bunsen carbon is substituted for the platinum. M. H. O.

Editors Electrical Review:

On page 553, "Text-book of the Principles of Physics," by Alfred Daniell, I find, "Two fluids or melted substances separated by a porous diaphragm will give a current [of electricity] even though the plates of the *same* metal be immersed, etc., etc., will give a current, and as the *one* metallic plate is dissolved away the other is thickened." The italics are my own. If this be true the dreams of perpetual motioners are realized. For when the metal in one solution has wasted away and the other increased in size, the two plates may be made to interchange places and the process repeated.

Yours, truly,
STUDENT

Telephonic News

*** An exhibition of electrical appliances is being held this month in the city of Mexico. The streets of Mexico have been supplied with electric light for over two years. The plant is now to be extended by the addition of 40 arcs. The town of San Luis Potosi, has ordered the erection of the same number of arcs for street lighting.

*** A Central News Brussels correspondent says: A convention has been signed between France and Belgium, providing for the establishment of telephone lines between Paris and Brussels. The work will be taken in hand at once, and it is hoped everything will be finished by January next. The charge for the use of the telephone between the two capitals will be 3 francs for five minutes' conversation.

*** The *Central'blatt für Electrotechnik* announces that the trunk line between Munich and Augsburg has been completed, and the results are very satisfactory. The town of Wurzburg is to be provided with a telephone exchange. Upon the German State lines Siemens transmitters have been exclusively employed hitherto; these are now to be given up in favor of a transmitter of the simple microphone type.

*** Two patents were recently issued to Mr. Lucius J. Phelps on duplex telegraphy. Under these inventions it is claimed that the same wire used for telegraphing to or from trains may be worked "duplex," thereby enabling it to be used as an ordinary Morse wire between stations, and simultaneously used for telegraphing to and from moving trains. The sys em is now being applied by the Phelps Telegraph Company upon the Lehigh Valley Railroad and the N. Y. & N. H.

*** The Okonite Company report that their business is rapidly increasing. Their factory is now running day and night on general orders; among them is one for a large cable for the Western Union Telegraph Company and another for electric light wires to go to Chicago.

They have just finished an additional building for the purpose of armoring submarine cables and underground electric light wires; new machinery for the same is now being placed in position. Their wires are giving general satisfaction to their customers, among whom are many electric light companies.

There appears to be a general satisfaction that the Okonite compound is not affected by extreme cold weather as has been proven by the amount of wire that was placed underground last winter when the temperature was way below zero.

*** There is on exhibition in Wells, Fargo & Co 's bank, at San Francisco, a bit of auriferous rock that any individual might be glad to possess. The nugget is one of the finest ever unearthed in California, both in size and richness. It is irregular in shape and about the size of an ordinary Derby hat. That there is very little rock and a great deal of gold in it may be determined by its weight, which is 35 pounds troy. Quartz of this sort is usually valued at $200 per pound, and, allowing the large margin of $1 000 for rock, the nugget would be worth $6,000 The exposed rock and great gobs of gold that hang out of its sides so as to nearly hide all other composition, and make it appear almost as melted metal, are not jagged or rough, but, on the contrary, are smoothed and polished in a manner that only water is capable of. The proprietors of the nugget are Messrs. Hayes and Steelman, of Sierra City, and they have left it on exhibition for a few days. At the bank it attracts much attention, but the employes could furnish no information concerning it beyond that it came from Sierra county and near Sierra.

Report of the Subway Commissioners to Mayor Whitney, of Brooklyn, N. Y.

The Board of Electrical Subway Commissioners of this city, consisting of George W. Plympton, R. W. Raymond and John Reynolds, have sent to Mayor Whitney a report of their proceedings during the year. The Commissioners say:

The underground conduit described in the reports of this board dated September 15, 1885, and April 3, 1886, as then proposed or in progress, has been substantially completed. The total length of underground conduits finished during the year is 65,000 feet, the maximum capacity of the same is estimated at 7,400 miles of wire. There have been drawn into the subway, up to December 13, 1,121.3 miles of wire, which is to be connected and brought into service as rapidly as possible. The number of conductors now working (December 13) in the subway is 805, comprising 445 miles of wire, which replaces 274.7 miles of aerial conductors. The latter are in process of removal. 82.6 miles having been taken down thus far—38 2 on Washington street, and the remainder principally on Boerum Place. The removal of telephone wires from Fulton street, near the City Hall, will commence within a few days and the work of replacement and removal will be extended to all the streets embraced int he plan already reported by the board.

It is proposed to extend the present underground system for telephone and telegraph conductors during the coming season. The plans for this purpose are not sufficiently perfected to permit publication at this time.

The only important telegraph line the owners of which have not yet taken steps to place their conductors underground, is that of the Baltimore and Ohio Telegraph Company. This company's wires in Brooklyn consist mainly of through lines, simply traversing this city to gain an entrance to New York. There seemed to be, at first sight, no reason for delay on the part of this board in requiring these lines to be put underground. But upon further inquiry it was found that the Baltimore and Ohio Compauy was employing a system of multiplex telegraphy, concerning which there might be a question as to its successful operation for a considerable distance underground, particularly if the underground section were interposed between overhead sections. It appeared but just to permit the company to make such preliminary experiments as might be necessary, before requiring it to adopt throughout its Brooklyn lines an underground system.

Among the questions involving points, which need further study, that of the electric light conductors is one of the most important. After the organization of the board, the electric light companies reported to it, as did the other electrical companies, the number and location of their wires, and declared that they had no plan to propose for putting such wires underground.

This made it the duty of the board to devise such a plan, if possible. The subject has been studied with care, but not as yet with the necessary completeness; and the reason of this relative failure is lack of means already explained. With regard to the electric light conductors, the board has found no device which would with certainty, in its opinion, enable the wires carrying arc light currents to be safely and successfully operated in the same conduit with telephone and telegraph conductors without disturbance or injury of the latter. Hence the consideration of the arc light conductors must have reference to independent conduits kept at a distance from the telegraph and telephone conduits. The following points are suggested, and their number might be increased:

1. It is a question to what extent the arc light currents, especially those of certain systems, involving very high potentials, or so-called alternating currents, can be successfully maintained in insulated conductors underground. As will be seen in the report of the president of the board, herewith transmitted, this problem has not been solved, or even attempted in practice abroad. The foremost practical electricians of Europe have simply avoided it. To discuss such matters technically is not the purpose of this report; but the board desires to say emphatically that those fluent critics who talk of putting electric light conductors underground, making no distinction between arc lights and incandescent lights, or between the arc lights of different systems, are ignorant of the alphabet of the subject.

2. If it should prove upon thorough and unbiased investigation that some electric light conductors can be successfully operated underground, while others cannot, the result of an imperative order in this direction would be to drive out of the city the systems which could not go underground. But some systems of which this might prove to be true are among the best in all other respects. The characteristically American "alternating current," for instance, is asserted to give a more uniform light than any other. Before enforcing such distinctions among the different competing systems, the board must have better opportunity to judge and, to that end, opportunity to examine and test.

3. It has been a question whether and in what circumstances the electric light companies employed to light the streets under contract with the city could be legally obliged by the board to place their wires under ground. This question has never been a pressing one because the board not having devised a practicable system to include such wires, could not issue such an order, if it had the right. Recently, however, in view of the general public interest in the subject, the board obtained through your courtesy the opinion of the Corporation Counsel—which, not being a city department, it had no right to ask directly—on the question whether its jurisdiction extended to the prevention of stringing overhead of such conductors That opinion is able and elaborate, and confirms in every essential particular the views entertained from the beginning by the board. It may be summed up in the declaration that the board possesses under present circumstances no such power, but that it will be the right and duty of the board to order under ground the electric light wires employed by contract with the city, so soon as a proper and suitable method for so doing shall have been devised.

This raises, however, for the consideration of the board, another question, namely: If the city authorities have made contracts at a certain price for lighting the streets, could this board properly impose upon the contractors an underground system, which, though technically practicable, was financi ally impracticable, under the terms of the contract; that is to say, would inevitably force either the abandonment of the contract, or the payment of a higher price by the city? This would certainly bring the board into an undesirable and mischievous attitude of conflict with the city authorities. Although the letter of the statute, as the Corporation Counsel has clearly shown, leaves the wires of contractors subject to the authority of the board, the spirit of the law evidently is that the city shall not by the action of the board be involved in expense or liability before its constituted authorities shall have fully considered the subject of proposed changes and appropriated the money to make them. It was plainly the wise intention of the law not to supersede the local self-government of the city by the constitution of this board for a temporary and special purpose. If the board, by dictating certain conditions to contractors, should force upon the city the alternative of either giving up its experiment in electric lighting of the streets or paying a much larger sum for that service, the practical effect would be the same as if the board had ordered the city to give up its fire and police telegraphs, or to put them underground at great expense. Furthermore it is conceivable that such an order as to contractors' wires might leave the city practically no alternative at all but the return to gas. In that case the question would arise, whether this result would serve the public interest; and it would be a fair inquiry in that connection whether the citizens of a given location would rather bear the nuisance of overhead wires than go without the electric light.

An immediate attempt to put underground all the police and fire wires of the city, so as to make those departments depend wholly upon an underground system, would be, in the opinion of this board, unadvisable. If independent conduits were constructed for the purpose, the cost would not be less than $5,000 per mile. Moreover, there are some peculiar necessities of the fire and police service which require that the underground system should be cautiously tested before general introduction. For such tests the present subways, in which space has been expressly reserved for the purpose, offer a favorable opportunity; and the board recommends that the sum of $5,000 for each of the two departments be appropriated for the purpose of purchasing, laying and operating suitable conductors in the present subways.

If the experiment proves satisfactory, there will be no difficulty, and little expense, in extending the system wherever the telephone and telegraph subways constructed by private companies give a ready-made conduit for it. The question of a further extension at the cost of the subways constructed by the city, must be left to the authorities.

The board begs leave, however, to call attention to the circumstance that the continued existence of overhead conductors belonging to the city departments prevents in many cases the removal of poles from the streets, even after the telephone and telegraph wires have been taken from them. The latter wires will be removed as fast as they are superseded by the cables in the subways; but so long as the poles are required for the fire and police wires they must remain. The plan suggested above of beginning the introduction of a fire and police underground system, with the experimental use of the compartments provided in the existing subways, will tend to remove the city wires from poles where they are the sole remaining lines, and thus permit the entire removal of the poles.

The board earnestly hopes, therefore, that the necessary appropriations for this purpose will be provided at the first opportunity.

During the summer the President of the Board visited the principal cities of England and the continent of Europe, including all places where underground electric systems of distinctive character were reported to exist. His report to the board is herewith transmitted. It is interesting and valuable as the first authoritative statement from a competent source, and from personal examination and investigation, of the actual condition of foreign practice in this matter. Notwithstanding the assertions so confidently made by irresponsible persons, it appears after careful inquiry, that there is no city to-day where greater progress has been made in the direction of an underground system than in Brooklyn. In the one or two cases which constitute seeming exceptions, the problem involved has been much simpler than that encountered here. That such substantial progress has been made under such necessary and unnecessary hindrances, is a result contemplated by the board with some justifiable pride.

Accompanying the report to the Mayor, Professor Plympton makes a s tatement embracing the result of his observations on the telegraph and telephone systems of Europe, mentioning the perfection to which they have been carried, the cables being principally laid in conduits beneath the surface of the roadways in London. On the continent they are carried on housetops, hung upon light supports. In his communication Professor Plympton declares that "there are more telephones in use in New York City and Brooklyn than in all Great Britain, and more in New York City alone than in all France."

*** The *Tribune's* Washington special says: In the sundry civil bill is an item of $100,000 "for payments of assistants to United States district attorneys." The appropriations committee must expect either that the senate will increase the amount or that the house may be called on to vote a big

deficiency next year. Out of this item must come the money to pay the counsel in the government Pan-Electric suit to break down the Bell patent. Information in the possession of the appropriations committee shows that down to this time the array of government counsel in that suit stands as follows: Hunton and Chandler, $5,000; ex-Solicitor General Goode, $5,000; Mr. Shipman, $2,500; Mr. Lowry, $100 per day in court and $75 per day when engaged on the case outside of court, five hours to be called a day; ex-Senator Thurman, $1,000 as retainer and as much more as his services shall be deemed worth. It will be seen that the telephone litigation into which the government has been drawn by the Pan-Electric statesmen will absorb a large share of the appropriation for the next fiscal year, as it will also of the appropriation for the current year. It is whispered that before the end of the session the attorney general will ask for a big deficiency appropriation for the current year, and it may be worth while for Congress to find out how much of it is required to meet liabilities incurred on account of the futile attempt of the department of justice to maintain a suit in Ohio against a corporation whose home is in Massachusetts.

The Hartford Light and Power Company—The Pioneers of Underground Conduits in Hartford.

The Hartford Light and Power Company is the name of a corporation just formed in Hartford, and for which articles of association have been signed and stock subscribed for by Messrs. William F. Henney, B F. Simmons, David Henney, David Henney, trustee; P. H. Woodward, and P. H. Woodward, trustee.

The purpose of the corporation is to furnish light for illuminating purposes, and to furnish and distribute power for various purposes. The company will operate under the Mather system of incandescent lighting, and will furnish light of any capacity for interior use. For the present the mechanical apparatus of the company is in the east end of the main building of the Hartford Steam Heating Company. The space occupied is being enclosed, and a well-equipped engine room will soon be presented.

The business management and general superintendence has been placed with David Henney, who is one of the heaviest stockholders, and an example of his ability to perform these duties lies in this single fact. On Friday night of last week, he was notified that he would be expected to illuminate the first floor of the Plimpton building for the Tyler Post fair on the Tuesday evening following. There had been nothing done in a preparatory way, the dynamo was in the shop and, as late as Saturday, the engine was on the car in the freight yard of the railroad company. But Mr. Henney is an energetic man and he set to work to organize his lightning-manufacturing forces, and what did he do? He had two sixty horse-power Westinghouse automatic engines unloaded from a car and carted to the building. They were haulded upon the foundation built for them, and one engine was set up and steam connections made with one of the large boilers of the Steam Heating Company. A Mather dynamo, of guaranteed power of 600 lights, was placed ahead of the engine and secured to its foundation, the two were belted together, and at 3 o'clock on Monday afternoon the two machines were working, the maze of wires had been stretched from the dynamo to and about the exhibition building and connected with forty suspended globes, and the undertaking had been successfully prosecuted. A series of tests were made, Mr. Charles H. Knox conducting the electrical arrangements, and in the evening the busy workers at the fair were furnished with a brilliant illumination.

WIRES TO GO UNDERGROUND.

For the present the company will use the overhead plan of stretching wires, continuing this only until permission can be obtained from the city to use the streets for the purpose of laying trenches for their cables and wires. The plan at present is to place the conduits two feet or more beneath the surface of the street and close to the gutter stones, the wires in the conduits to be properly insulated and then all to be covered with insulation. At convenient places there will be test and cut-out boxes, so that repairs and extensions can be made.

Regarding the prospects of the new company it was learned that orders had already been received for the illumination of adjacent buildings and enough to employ the present capacity of the machinery. Additions will be made as fast as possible to the dynamo power. The field of interior illumination has been pretty carefully estimated, and the company is confident of meeting every desire. At first, attention will be paid to the wiring and illumination of stores, and their residences will be attended to. The lamps used by the company can be attached to gas brackets or chandeliers and the wires introduced without defacing a building or changing the ordinary fixtures. Improvements have been made so that the density of the light can be regulated the same as with gas, and lights not desired can be turned out and renewed at will. The four illuminating points in the little globe burn with such perfect steadiness that the eye is neither dazzled nor tired in looking at it.

The Field Telegraph.

The articles on Field Telegraphs, which are being published in the *Military Telegraph Bulletin* are interesting to some telegraphers. From a late issue we extract the following:

"PRESENT ORGANIZATION IN THE BRITISH ARMY.—There is now in our army a Telegraph Battalion of two divisions. All the telegraph service in the field is performed by them. In peace time, one division, with wagons and horses, is stationed at Aldershot, and trains officers and men for field telegraph. The other division maintains, under the Engineer-in-Chief to the General Post-Office all the State telegraphs in the South of England and Channel Islands. For war purposes, sections of about fifty men are formed a certain proportion from each division. The system has shown itself an admirable one, and the most economical a State could maintain. But, in matters of this kind we must look forward to what is likely to be demanded in the future, and not measure our requirements by the past alone. The uses made of the telegraph for war increase as its powers become more recognized. In years to come it will be considered as great an anomaly to send a body of troops on any detached duty in the field without its connecting telegraph line, as it would be to send a man who was dumb as a Member to the House of Commons. To avoid any strain on the English State telegraphs, caused by the withdrawal of too many of those employed on them for foreign service, the writer advocates an increase in the number of trained officers and men. Of training, he says: Though the duties in the field may look simple, it nevertheless requires a long and careful technical training to give a man the requisite qualities. The maintenance of telegraphs admits of no hesitation, no mistakes, and no fear of responsibility.

"The telegraphs in our army, the writer adds, have been a great success, and the organization is undoubtedly the best in any European army, and is recognized as such. He, however, warns us of the danger of being satisfied with past successes. What has been done has only been the simplest kind of field telegraph work. There have been only single lines of communication, and no complicated problem. It will be different in a European war, where the advance into the enemy's country may be by several main roads, and cross-communications and numerous branches necessary. When the telegraph of the country will have to be taken over and worked, not for military purposes alone, but also for the civil government of the country, instruments of a far more complicated nature than those for field use would become necessary, and such an organization indispensable that could only be worked by officers and men who had undergone a long training in peace. The field telegraph has hitherto been equal to what has been required of it; but to provide a trained *personnel* for a field of action, such as has been sketched, would be beyond it, without unduly straining the State telegraphs at home."

Examination in Electrical Measurements.

COURSE IN ELECTRICAL ENGINEERING, CORNELL UNIVERSITY, ITHACA, N. Y.—FALL TERM, 1886.

1. Define the ohm; the ampere; the volt. Also, the legal ohm, ampere, and volt.

2. Describe briefly the method used by the British Association committee, and afterward by Lord Rayleigh, for determining the true value of the ohm. Show what quantities must be observed.

3. Describe and demonstrate Cary Foster's method of comparing resistances by means of the divided metre bridge. Show how this may be applied to calibrate the bridge wire, and determine its resistance per unit length.

4. In determining H by means of the Kew magnetometer, show how the length of the deflecting magnet is eliminated, and explain the corrections for temperature and induction.

5. Deduce the expression for the potential due to a magnetic shell, and reduce to simplest form involving linear quantities, for a shell with a circular edge, for a point on the axis of the circle. Also find the expression for the force in the direction of the axis on a unit pole.

6. What is the advantage of the Helmholtz over the single coil tangent galvanometer? Why is the distance between coils made equal to their radius? Describe the "Vienna method" of measuring currents.

7. Describe briefly the two forms of Ayrton and Perry ammeters. State their advantages and disadvantages. Describe the Siemens ammeter (dynamometer form).

8. How can potentials be measured in legal volts? Describe some of the portable voltmeters. How does temperature affect their indications? Why?

9. What can you say of the use of cells as standards of difference of potential? Give briefly the method pursued by Lord Rayleigh to determine the E.M.F. of Clark's cells.

10. How is the influence of errors of observation on a result to be determined? Explain the bearing of this upon the number of places of significant figures to be retained. Apply to the case of the measurement of current by a tangent galvanometer and suppose deflections can be read only to tenths of a degree.

The Gymnotus Electricus, or Electric Eel.

For two months of the present year, an electric eel was kept in one of the aquaria at Eugene Blackford's establishment in Fulton Market, where it was the source of much amusement, as well as of a certain amount of distress, by the shocks it gave to those of an investigating or curious mind. Toward the end of its captivity the writer received one of its shocks. It was but a feeble one—comparable to that from a pint Leyden jar. The fish was then growing weak, and shortly afterward it died. Thus the shock could only be considered an indication of what it might do if in good health. A snapping turtle which was in the same compartment with it was once so badly shocked that for ten minutes it floated upon the surface of the tank senseless.

By the kind permission of Mr. Blackford, the eel was dissected. This was an operation of much interest, as the eel was the largest one he had ever had possession of.

Its general external appearance does not differ much from the ordinary eel. On cutting it open, the first thing that impressed one was the disproportionate size of the electric organ. The fish was 34 inches long and weighed 3½ pounds, and one-seventh of this weight was represented by its battery. The abdominal regions were confined to the forward part of the body, next to the head. The rest was all muscle, bone, and electric organ. Though this fish was an unusually fine one, a length of five or six feet is often attained. Its exact place in the kingdom of fishes is not satisfactorily settled, as it differs in many respects from the true eels. Its fins, confined to pectoral and anal, are covered with a thick skin. It has no dorsal, ventral, or caudal fins. Its vent is very far forward, just back of the jaw.

Michael Faraday's researches in the matter of the electricity of the Gymnotus are classic. His paper detailing the result of his experiments was read before the Royal Society on December 6, 1838. It may be consulted in the collection of his "Experimental Researches in Electricity," published by Quaritch in 1844, and recently reprinted in facsimile.

He collected electricity under different circumstances, and tried many experiments with it. He used two kinds of collectors. In one of them, a copper disk, one and a half inches in diameter, was brazed to a copper rod 15 inches long, with a copper cylinder for handle, the rod being insulated with a thick India rubber tube, In the other, a plate of copper, eight inches long by two and a half wide, was bent into a saddle shape, and its outer surface covered with caoutchouc. A wire was brazed to it and insulated by a rubber coating. With the first kind of conductors, the handles being wet, shocks were obtained when one collector was held in each hand and applied to different parts of the fish. The saddle collectors, properly applied, gave current enough to deflect a galvanometer that was not very sensitive. With a helix of 22 feet of fine silk covered wire wound on a quill and placed in the circuit, a wire was magnetized, and its polarity indicated a direction of current from the anterior to the posterior parts of the animals. Iodide of potassium was readily decomposed, iodine appearing at the end of the wire connected to the forepart of the Gymnotus. By carrying out this line of experimentation, he ascertained that "within certain limits the condition of the fish externally at the time of the shock appears to be such that any given part is negative to other parts anterior to it, and positive to such as are behind it."

He repeatedly obtained the spark by placing a spark coil in the circuit, with files as circuit breakers. Subsequently a revolving steel plate, cut file fashion on its face, with a wire to bear on the roughened surface, was used. Connecting one piece to one saddle collector, and the other to the second one, applying them to the fish's body, and exciting it while moving one electrode over the rough surface of the other, a spark was repeatedly obtained. His object in this experiment was to secure a break in the current while it was passing.

By a rough comparison with Leyden jars, he concluded that a single medium discharge was equal to the electricity of fifteen Leyden jars with 3,500 square inches of glass, coated on both sides, and charged to its highest degree.

His general theory of the action of the fish is that a current is discharged from the head to the tail through the water as conductor. If any sensitive object, as the human hand, is placed in an intermediate part of the water, it will receive a slight shock. If the hand grasps the fish, it will also be a portion of the connecting conductor, and will be shocked up to the point of immersion. If both hands grasp it, the shock is received in great intensity, as the body all comes into the circuit. The farther apart the points of the body thus grasped were, the worse was the shock.

By bending into an arc, the fish can send a current across the chord with much force. Faraday saw it stun a fish in this manner before devouring it, coiling in a partial circle around its victim before discharging its battery. A curious feature in its disposition to discharge itself was that it would only do so repeatedly when touched by a sensitive object. Disturbed by a glass rod, it would give a few shocks, and desist; but on touching it with the hand, it would again discharge itself. This Faraday attributes to the recognition obtained by the fish from the convulsive movements of the hand of a sensitive organism. When this movement was not perceived, the fish soon desisted from shocking.

When Mr. Blackford's eel was in full vigor, many persons were shocked by merely putting their hands in the water. It was also remarked that the shock from contact with a single hand was not necessarily confined to the immersed portion.

ELECTRICAL AND SCIENTIFIC

* * Your correspondent yesterday talked over a telephone wire from 53 South Third street Philadelphia, to 140 Fulton street, New York, with a gentleman there, and the conversation was just as audible and just as clear as if held between two persons in the same room. The lines between such distant cities are those of the American Telephone and Telegraph Company—and are in connection with all the American Bell telephone offices in all the cities yet connected—including New York and Philadelphia, Jersey City, Brooklyn, and as far east as New Haven. And the company are now building a line of thirty new wires between New York and Boston, which will be completed and in working order early in the spring. Since the completion of the line it has been found to be absolutely perfect in operation under any and all climatic conditions. From Philadelphia communication is had with over 15,000 stations in the cities above named. The line from New York to the Delaware River was completed in April last, but some delay occurred then in getting an ordinance from Councils to lay the wires underground here. Now the latter are laid from the Delaware to Fifteenth street on Walnut street, and on Fourth street from Walnut to Arch, and as early in the spring as the weather will permit the system will be extended to the Schuylkill River on Walnut street, and from Washington avenue to Girard avenue on Fourth street, thus taking in the entire active business section of the city. The Philadelphia local office is at 53 South Third street, in charge of Mr. H. A. Pitcher as manager, and the operating department is at 148 South Fourth street, and there are public stations at the Continental, Girard and Lafayette Hotels and at the Stock Exchange, and the system is being extensively leased by leading business houses here, and by others having business relationships with the cities named above.

* * A new electric company has just been formed in Auburn, N. Y., by General Manager Timpson, to be known as the Auburn Electric Clock Company: $10,000 capital paid in. There are seven trustees, as follows: Frederick I. Allen, W. L. Bundy, George Underwood, Fred. C. Timpson, Charles F. Davis, F. P. Casey and William P. Allen. The operations of the company are to be carried on in this city, and manufacturing will probably commence about the 1st of January.

* * The stockholders of the North American Telegraph Company have elected directors for the coming year. They are: W. S. King C. A. Pillsbury, George A. Brackett, H. F. Brown, C. M. Loring, Minneapolis; W. R. Merriam, C. H. Bigelow, Maurice Auerbach, A. H. Wilder, St. Paul; L. D. Parker, Chicago. The directors elected for president, C. M. Loring; vice-president, W. R. Merriam; secretary and treasurer, W. H. Eustis; general manager, H. A. Tuttle. The annual reports went to show that the wires of the company are nearly all strung so far as ordered, and that its business is in a very satisfactory condition. Next season the company will build a line from Minneapolis and St. Paul to Winnipeg. This will not be a continuation of the Duluth line, but will be entirely separate from it, taking a new route across country. The route has not yet been decided upon.

* * A telegram from Constantinople, last week, stated that the electric light on the heights of Siddul Barbar, at the entrance of the Dardanelles, has been completed, and has given so much satisfaction to the military authorities that further apparatus of a similar kind has been ordered for the other fortresses which command the different bends of the channel up to Niagara.

Testing Dynamo Machines.

As the first example of efficiency tests, that of two similar series wound machines may be taken. We will suppose them are light machines of high electromotive force. The motor and generator have their pulleys connected by a belt, and the machines are coupled up electrically in series with a small machine, *D*. If the small machine is run, it will send a current through the other two; but they will not start, as the torque will be the same in the two similar machines. This difficulty may be got over in several ways. Thus the motor may have a smaller pulley than the dynamo. The size of the pulleys should be arranged so that the small one is to the large as the expected efficiency of conversion of the two machines is to 100; that is to say, the difference should be enough to allow for the loss of power due to Foucault currents in the armature, to magnetism, and to mechanical friction and belt slip. If the pulleys are not the right size, either the current will come wrong, or the machines will not run at their normal speed. Let us suppose that the pulleys are chosen correctly, and that one of the machines, say, the generator *G*, is to be tested. We will take its working conditions to be 2,000 volts, and 10 amperes at 900 revolutions. The small dynamo *D* is run up till it gives 10 amperes. The large machines will run quicker and quicker till the product of their torques and speeds is equal, or only differs enough to allow for belt slip; this will be at their normal speed if the pulleys have been correctly chosen.

We will assume hypothetical readings and work them out; *G* gives 2,000 terminal volts, the loss in the armature calculated from the hot resistance is 120 volts with 10 amperes, and in the field 120 volts. We will suppose the current to be quite steady; then using Prof. Thompson's lettering for the sake of uniformity; the terminal electromotive force $e = 2{,}000$, on the brushes it is $\varepsilon = 2{,}120$, and E the armature electromotive force is 2,240 volts. The motor M is $e = 2{,}721$ and $\varepsilon = 2{,}601$, E = 2,481. We have therefore 2,481—2,240=241 volts spent in other ways than in overcoming the resistance of the wire of the machine, and the problem is to divide this loss fairly between the two machines. The losses in power, due to different causes, vary differently with the speed. For instance, the power lost by Foucault currents varies nearly as the square of the speed, while the loss from persistent magnetism is probably as the speed. It is most likely the best way to distribute the loss as the square of the speeds. In choosing the hypothetical readings the efficiency of conversion was taken at 95 per cent., so that G ran at 900 and M at 1,000 if there was no belt slip. Then the 241 volts, or 2,410 watts, will be distributed, M 1,330 and *G* 1,072. The armature of *G* gives 22,400 watts, so that the whole power given to *G* is 23,472 watts. In the same way the motor has e=2,721, ε=2,601, E=2,481, so, as 130 watts are lost it transmits 23,480 watts. The eight extra is here due to the use of the slide rule. This supposes that there is no belt slip, but take the belt slip =1 per cent. as the reading obtained by comparing the observed and calculated speeds of the dynamo shafts. A belt slip of one per cent. is 235 watts, and this power is part of the 2,410 watts not accounted for by the electrical resistance of the machine. This leaves 2,175 watts to be divided between the the two machines. That gives *M* 1,211 watts and *G* 962 watts. The reason why the motor and generator were taken as similar machines in the example is that it is the only way this particular loss can be accurately determined. If the machines were not alike, it would be easy enough to determine the efficiency of the two machines taken together, but the loss in one alone could not be so well separated. We have found that the generator *G* receives 23,362 watts, which is spent as follows:

	Watts.
Loss in armature by resistance.....	1,200
" " in field-magnets.....	1,200
" " mechanical friction, Foucault currents, persistent magnetism, etc., in the armature.....	962
Total loss in the machine	3,362

Efficiency, 84.6 per cent.

If the current is not steady, some precaution becomes necessary. The main current must not be measured with an ordinary ammeter, but an electro-dynamometer must be used. Such an instrument does not really indicate the current, but gives what may be called the virtual current, which, when multiplied by the virtual electromotive force, taken with an electro dynamometer voltmeter, without self-induction, gives real power spent in any part of the circuit that is resistance only—that is, has no electromotive force, induced or otherwise produced. Again, if the current is variable, the loss in the fields is greater. To get the loss in the fields, an electro-dynamometer, without self-induction, must be set to measure the power; it will not do to measure even the virtual volts and amperes with two separate instruments and multiply them together, for there is an electromotive force induced in the field coils when the current varies. This method cannot be applied to the armature, so the additional loss due to the variation of currents must be put in with the power unaccounted for by the resistance of the machines. It is probable that two machines, each of which alone gives a varying current, would, when coupled together and run at

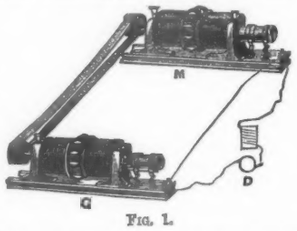


Fig. 1.

slightly different speeds, give an approximately uniform current. Instead of electro-dynamometers, electrometers may be used. Enough has now been said to show the great advantages of this method of testing machines. The whole of the tests are taken without any mechanical dynanometers, and even the instruments need not be correct. It is a common practice among electrical engineers to measure resistances in B. A. ohms, and E M.F. in what would be "legal" volts, if they were a good enough shot to be anything at all; but all that is demanded with this method is that the instruments are correct throughout their scales with regard to themselves. If the instruments are not correct, or even consistent with one another, but consistent each with its own scale, the result is not a false estimate of the efficiency of the

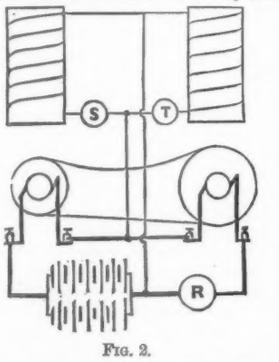


Fig. 2.

machine, but merely some slight errors in the distribution of the loss of power. The machine will also be run at a slightly different load.

If very great accuracy is not required the machines need be similar, for if they are both are machines, or at least both work with the same currents, the motor M may be any machine that is powerful enough. Care must then be taken to assess the loss of power and of belt slip properly.

If the machines are at the same speed the belt slip may be avoided by coupling the shafts of the machines together rigidly, as in Dr. Hopkinson's method. This lessens the friction of the bearings if the shafts are set exactly true, but the belt has the advantage that the machines are run more nearly under their normal conditions, and the tests are therefore more valuable, though the efficiency does not come out quite so high.

The arrangement in which the speeds of the dynamos with their normal currents depend solely on the relative diameter of the pulleys is defective, as it does not admit of any fine adjustment. This adjustment is managed by shunting one of the fields or one of the armatures. Thus, suppose G is found to run too fast, a shunt across either the brushes or the field of M will make it run slower.

If a low resistance voltmeter is used, with enough resistance in series to take the high electromotive force, it may itself take a current large enough to interfere with the test. An electrometer has not this disadvantage.

As our next example we will take two similar shunt or compound machines. First let them be shunt machines. We may suppose the test made with two Edison-Hopkinson machines like those tested at Manchester. Fig. 2 shows two such machines coupled with pulleys of different diameters. The first thing to do is to find the revolutions and relative sizes of the pulleys needed. The normal speed is 750, and the armature electromotive force E is 108.6 volts, and ε and e are 105 volts. The machine is run as a motor with no load till it has a back electromotive force of 108.6 and a speed of 750. The field will then have a little less than 105 volts on it.

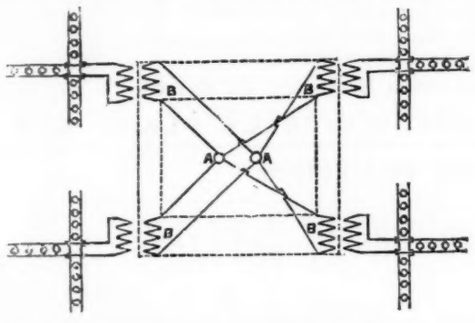
But the armature will be under conditions almost the same as when running at full load as far as Foucault currents, persistent magnetism, etc., are concerned. The electrical power now spent in the armature will give the data required for calculating the pulleys. Let the figures be 109 volts and 24 amperes in the armature, or 2,683 watts. The armature of the generator has a normal current of 364 amperes and an electromotive force of 108.6 volts. It will therefore want 39,600 + 2,682 to drive it; allowing 1 per. cent. belt slip the motor must give 42,605 watts. As the motor will be going about 20 per. cent. faster than the dynamo, 3,580 watts may be allowed for stray power, so the armature must get 46,185 watts. As the generator excites both machines the motor current is 352, and the back E must be 131 volts; so the pulleys must be as 108.6:132. This assumes that the difference of current in the two machines makes no practical difference in the armature volts. The electromotive force at the brushes of the motor is ε=134.5, so secondary cells or another machine must be inserted to add 26 or 27 volts to give 131.5 volts on the motor. These cells then supply the loss in the whole system. The machines are coupled up as shown in Fig. 2. The cells are shown in the main circuit, and there is an adjustable resistance *R* in the main circuit; the shunt circuits have also an adjustable resistance in each. To start the whole system the main circuit is made; the connections must be made so that the fields are to some extent excited by the cells to start with—that is to say, the resistance *R* must be in the armature circuit, but not in the field circuit. One objection to this method of testing two shunt machines may be the difficulty of starting. To start, the resistance *S* in the motor field circuit may be taken out, and the field of the generator left open and then closed through a high resistance which is gradually taken out. Let us suppose the machine started, and the main resistance and the shunt resistance adjusted till the generator is running under its normal condition. The power lost in each field is then determined, and the loss by armature resistance is calculated for each machine; the loss not thus accounted for is the total loss through friction belt, etc., and is distributed in the same way as in the case of the series machines. If the first calculation of the sizes of the pulleys is wrong, the motor must have its field altered by the resistance *S*, but it is not likely the error will be large enough to allow any perceptible error in the distribution of the stray power.—*London Electrician.*

Distribution by Transformers.

We learn from the *Æsterreichisch-ungarisches Patentblatt* that Messrs. Siemens and Halske propose to effect the distribution of electricity from central stations, by subdividing the area to be supplied into several smaller districts, and distributing electricity in parallel mains, in each such sub-district, by means of large transformers, which are themselves to be supplied with current from the central station. In the publication from which we obtain these details, Messrs. Siemens and Halske set forth the disadvantages attending the employment of transformers upon parallel circuits, such as the amount of copper which is required for the mains (since the potential must be kept constant and equal at every transformer on the circuit, irrespective both of the number of lamps and transformers in use), and also the objection of bringing into the consumer's premises very nearly the full tension of the dynamo. They then refer to the difficulties connected with the regulation of transformers when connected in series, for which no solution has yet been made known; and finally they explain a method of connection by which it is proposed to obtain perfect regulation without incurring the difficulties of the parallel system. The connections proposed are shown in the accompanying figure, where *A A* are the terminals of the alternating current machines at the central station. Any required number of machines joined in parallel may be employed. From these points mains are carried directly to the terminals of the primary coils of the transformers (*b*) in each sub-district, and the latter are again joined in parallel, by additional submains, as shown by dotted lines.

Although we believe that the plan of using transformers as sub-centers of distributions is good and practical (though even this was, perhaps, scarcely thought of first in Berlin), yet as to the arrangement of the circuits it is certainly neither more nor less than a connection in parallel combined with a system of feeders such as were first employed by Edison. By splitting up the main current, a saving of copper over that required for a single parallel going all round the circuit is of course effected, but it is very doubtful whether, in any given case, this economy would not disappear by the time that the sub-mains between the several districts have been provided for *

Our chief objection, however, to the scheme, so far as it has any pretension to be considered as a step towards a general and final solution of the problem, arises from the fact that it is essentially a central station system. Not only must the central station be centrally situated in order to secure economy, but the transformers must also be placed in the centers of their sub-districts. From this point of view it is almost to be considered a retrograde step, for one of the chief advantages to be gained by the use of transformers arises from the facility with which, if they could but be employed on series circuits, ex-central distributing stations are immediately available. The importance of any system which admits of the use of high tension currents in a system of general distribution, so as to enable the machine to be placed upon the outskirts of the area to be supplied, is fully appreciated, but this the scheme of Messrs. Siemens and Halske does not effect.



* The authors state that the dimensions of the sub-mains will be so taken as to provide an adjustment for all ordinary discrepancies between the rates of consumption in different districts. In order to provide against extraordinary departures from the normal balance, they contemplate the introduction, when necessary, of resistances in the circuit of the main leads of those transformers which are doing minimum work. But it appears to us that the whole of this part of the scheme is based, to some extent, upon a misconception. In giving an illustration of the supposed action, it is stated in so many words that if the potential at the machines remains constant, then the current in the main lead belonging to any given transformer tends to increase when the number of lamps in the secondary circuit of that transformer is diminished. It is, however, tolerably well known (and it may readily be proved by theory) that the reverse is really the case. An easily-remembered rule of thumb clue to the elementary conditions of transformer circuit may be given by stating that the virtual resistance of the primary coil varies in the same direction as the actual resistance of the secondary. Consequently, when lamps are turned off, the actual resistance of the primary is increased, and under constant difference of potential the current through the coil diminishes (instead of increasing, as stated by Messrs. Siemens and Halske). Owing to the loss of potential in the mains, this decrease of current tends to cause a slight rise of potential at the terminals of the primary; but in the system under consideration this is to some extent counterbalanced by the fact that the presence of the sub-mains diverts into this route a portion of the current passing through the other primary coils. The proportion of current so diverted obviously depends solely upon the relative resistances of the various mains and sub-mains. To secure perfect compensation in this way, it is necessary that the resistance of all the mains be equal to one another, while the resistance of the sub-mains ought to be a vanishing quantity (!) In fact, as above intimated, the particular connections described have nothing to do with transformers *qua* transformers, but resolve themselves into a system of parallel mains with feeders by which the difference of potential may be kept approximately uniform at all points.

Digest of U. S. Patents on Storage Batteries.

REFERENCES TO FOREIGN PATENTS OBTAINED THEREON.

(ELEVENTH PAPER.)

1885.

321,759. July 7, 1885. Filed March 27, 1884.
English pat., No. 5,741, Dec. 14, 1883.
John S. Sellon, England.

Relates to the means employed for separating the electrodes and consist in interposing between the respective plates, strip, plugs or discs of insulating material, such as hard rubber, clay, etc. The plates are retained in position by a binding device, capable of yielding under pressure.

323,890. Aug. 4, 1885. Filed Dec. 3, 1881.
E. T. & E. E. Starr, Philadelphia.

Construction the same as 268,308.

Claims—An electrode of two or more perforated plates. An electrode provided with receptacles and holes or perforations in the walls of the receptacles.

A perforated battery plate having receptacles for the material active in the battery.

324,597. Aug. 18, 1885. Filed Mar. 27, 1885.
English pat., No. 1,764, Feb. 9, 1885.
French pat., March 5, 1885.
J. S. Sellon, London, England.

Relates to electrodes formed of corrugated, horizontally-arranged plates, provided with openings, in which are located vertically-arranged plates. The plates may be perforated, and may be "formed electrically," or have mechanically-applied active material thereon.

325,120. Aug. 25, 1885. Filed Feb, 5, 1885.
English pat., No. 6,228, April 10, 1884.
French pat., Jan. 14, 1885.
German pat., 1885.
John S. Sellon, London, England.

Describes electrodes, pyramidal in shape or formed as a saddle, provided with ribs, corrugated or perforated. Spaces are arranged for the escape of gases.

327,341. Sept. 29, 1885. Filed Jan. 20, 1883.
Division of application of Dec. 31, 1881.
E. T. & E F. Starr, Philadelphia.

Relates to the process of mixing to a paste with a binding agent, the active material to be employed in a battery. The claims are for—

1. An active compound for use in electric batteries, consisting of active matter, and a binding agent therefor, mixed to a pasty or plastic condition with a conducting liquid.

2. The combination with a battery electrode or support of an active compound, consisting of active matter, and a binding agent therefor, mixed to a pasty or plastic condition with a conducting liquid, such as sulphuric acid.

3. An active compound for use in the manufacture of secondary batteries, consisting of finely-divided lead or lead compound, and a binding agent, mixed to a pasty or plastic condition with a suitable liquid.

Notice is given that an application has been filed for similar claims omitting the binding agent.

* * Messrs. Gaulard and Gibbs have just recived a United States patent for their method of electrical distribution and conversion, with the following claims: 1. The hereinbefore described art or method of electrical distribution and conversion, which consists in establishing in a closed electric circuit a current of alternate and equal positive and negative potential, producing by the influence of such current an inductive field of alternate polarity, and thereby inducing in translating devices situated in an independent closed circuit traversing such field a similar alternating secondary current of greater quantity and less potential than the originating or producing current. 2. In a system of electrical distribution, an inductorium or converter, in which the length of that portion of the conductor traversed by the primary current within the magnetic field created by itself exceeds the length within the same field of the conductor traversed by the secondary current, in combination with a dynamo electric generator producing alternating electric currents or pulsations of equal potential and duration, and translating devices actuated by said secondary current. 3. In a system of electrical distribution, an inductorium or converter, in which the resistance of that portion of the conductor traversed by the primary current within the magnetic field created by itself exceeds the resistance of that portion of the conductor traversed by the secondary current which lies within said field, in combination with a dynamo-electric generator producing alternating currents or pulsations of equal potential and duration, and translating devices actuated by said secondary current. 4. In a system of electrical distribution, a dynamo electric machine, organized for the production of alternate positive and negative currents, equal to each other in potential and duration, in combination with the primary circuit of an inductorium or converter organized to induce in its secondary circuit alternating currents of lower potential and greater quantity than those of the primary circuit, and one or more translating devices actuated by said secondary currents. 5. In a system of electrical distribution, the combination of an inductorium or converter, having its primary and secondary circuits constantly closed, a dynamo-electric generator for producing alternating currents of equal potential and duration included in said closed primary circuit, and one or more translating devices included in said closed secondary circuit.

* * As mentioned in last week's edition an electric railway has just been put in running order by the Scranton Suburban Railway Company, of Scranton, Pa., and moves with the regularity of clock work from the center of the city, at a point opposite the Delaware, Lackawanna and Western Railroad station, to a suburb called Green Ridge, a distance of about two miles. Two handsome Pullman cars have been placed on the track and are run smoothly and expeditiously along levels, around curves, and up rather steep grades. Each car affords seating accommodations for 26 persons. The motor is a small compartment in front, and the power is applied by cogs to the two fore wheels. A "traveler" running a wire strung at an elevation of a few feet above the car and about midway over the track conveys the power from the dynamo, which is in the works of the Scranton Electric Light Company, to the motor in the car and sets the wheels in motion.

ELECTRIC LIGHT NEWS

—— The Youngstown Car Manufacturing Company, of Youngstown, O., have just put in a twenty-light Brush arc machine and a Buckeye engine, which are giving the best of satisfaction.

—— F. Juneman, proprietor of the Brush Light Station at Chillicothe, O., has secured additional city contracts, and is fitting up his station with Brush apparatus.

—— The Sandusky Electric Light, Fuel, Gas and Supply Company, of Sandusky, O., are adding to their Brush plant, which they say is giving the steadiest light they have ever seen.

—— The Lafayette, Ind., Brush Electric Light Company, under the management of James T. Davidson, their president, is making rapid advancement. They have recently added to their station two forty-five-light Brush dynamos of 1,200-candle power capacity, and an engine, furnished by the Buckeye Engine Company, of Salem, O.

—— Messrs. Whitely, Fassler & Kelley, of Springfield, O., having one of the largest agricultural machine works in the world, have just put in a Brush arc light plant.

—— James Boyce, of Muncie, Ind., who is operating incandescence lights from a central station, has just added a Brush 1,200-candle power arc plant, and writes that traveling men say he has the steadiest and best lights they have seen anywhere. Mr. Boyce has also put in a Brush incandescence isolated plant at his flax works.

—— The Pittsburgh, Cincinnati & St. Louis Railroad Company are doing a large portion of their lighting by electricity. They have already lighted their shops at Dennison, O., Columbus, O., and Indianapolis, Ind., with Brush arc lights.

—— The American Tube and Iron Company, of Youngstown, O., have recently built what are stated to be the most complete tube works in the world. They have all modern improvements, including a Brush Swan incandescent plant of 3 0 lights and a Brush arc light plant of twenty lights.

—— The Mather Electric Company, of Hartford, are putting an 800 incandescent plant for Hartford Light and Power Company, and 800 incandescent and 25 arc lights for S. D. Warren & Co, of Cumberland, Me; also 600 incandescent for the Hennepin Avenue Opera House, Minneapolis, Minn., and 300 more for the Cincinnati *Commercial Gazette*. These are all December orders.

—— Thos. Pray, Jr., general superintendent of the Mather Electric Company, Hartford, Conn., tendered his resignation November 22d, to the president of the company. It was duly accepted Dec. 8th, and he will be at liberty Dec. 31st. We learn that he has not made any arrangement, and has not decided whether to enter the editorial harness again or to continue in the electrical field.

—— As an indication of the strong interest which is now being manifested among the gas people in the combination between the American Electric Manufacturing Company and the gas companies, it may be stated that a change has just taken place in the executive management of the American Company. Mr. H. E. Irvine, who has been so long associated with the company as treasurer, has accepted the presidency of the American Electric Construction Company, which is organized for the purpose of building electric light plants throughout the New York State, and Col. W. A. Steadman, Treasurer and General Manager of the Newport, R. I. Gas Company, and said to be one of the ablest gas engineers in the country, has accepted the treasurership of the American Company.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING DEC. 7, 1886.

354,111 Electric motor; Nathan H. Edgerton, Philadelphia, Pa., assignor, by mesne assignments, to the Edgerton Electric Motor Company, of New Jersey.

354,131 Electrical thermostat; Richard L. Guion, Elmira, N. Y.

354,139 Electro-phonetic telegraph sounder: Henry A. House and Henry A. House, Jr., Bridgeport, Ct.

354,169 Telephone; Wm. J. Morton, New York, N. Y.

354,209 Electrical annunciator; Gwynne E. Painter, Baltimore, Md.

354,233 Distributing appliance for electric lighting systems; E. Wilbur Rice, Jr., Lynn, Mass.

354,241 Telephone transmitter; Allen W. Rose, New York, N. Y.

354,257 Resistance block for electric circuits; Marmaduke M. M. Slattery, Woburn, Mass., assignor to the Sun Electric Light Company, same place.

354,258 Apparatus for electrical distribution; Marmaduke M. M. Slattery, Woburn, Mass., assignor to the Sun Electric Light Company, same place.

354,272 Apparatus for the distribution of electricity by means of secondary batteries: Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut.

354,273 Regulator for dynamo-electric machines; Elihu Thomson, Lynn, Mass.

354,274 Induction coil; Elihu Thomson, Lynn, Mass.

354,290 Underground electrical conduit; Benezette Williams, Chicago, Ill.

354,291 Insulating joint: David Williamson, Hartford, Ct.

354,292 Armature for dynamo-electric machines; David Williamson, New York, N. Y.

354,310 Manufacture of carbon conductors; Thos. A. Edison, Menlo Park, N. J.

354,320 Electrical conductor; Edward H. Johnson, New York, N. Y.

354,350 Conduit for cable or electrical railways; Edward Samuel, Philadelphia, Pa., assignor to William Wharton, Jr., & Co., same place.

354,352 Secondary battery; Victor Sass and Karl Friederich, Berlin, Germany.

354,402 Telephone receiver; Joseph C. Eichmeyer, Utica, N. Y., assignor of nine-tenths to Frank J. Collamen, Joseph R. Swan and Augustus H. Palmer, all of same place.

354,434 Primary galvanic battery; Charles E. O'Keenan, St. Cloud, near Paris, France.

354,466 Electric cut out; Charles Eschwei, New York, N. Y.

354,469 Adjustable support for telephones; Claude C. Gould, Batavia, N. Y., assignor of seven-eighths to Walter Smith, same place, and Phillip W. Scribner, Tonawanda, N. Y.

354,505 Electrical number indicator; William J. Cull and Charles F. Scattergood, Albany, N. Y., said Scattergood assignor to said Cull.

354,522 Thermometric regulator for heating apparatus; Jacob Trueb, New York, N. Y.

354,525 Circuit breaker for electric clocks; Vitalis Himmer, New York, N. Y.

BUSINESS NOTICE.

"In making the statements which follow we can verify each and all of them as facts. Mr. Edward P. Thompson, of Temple Court (7 Beekman St.), New York, is a good man to bring your patent cases to, for he is thoroughly versed in all the ins and outs of a Patent Attorney's duties. The following are some of his qualifications: Graduate of Stevens Institute as Mechanical Engineer. For four years tutor of classes of young men in mathematics and experimental physics at Elizabeth, N. J. Served professionally as Electrician and Chemist in the Swan Electric Company of New York for two years. Because of past successes in a Patent Attorney at 13 Park Row, New York, was appointed to succeed N. S. Keith, of the patent agency of the *Electrical World* and Associate Editor. N. S. Keith is known as the Translator and Reviser of Schellen's Treatise on "Dynamo Electric Machinery." Mr. Thompson for two years personally prepared and prosecuted all the patent business of *Electrical World's* Patent Agency, and is the author of a series of articles in said paper upon "Analytical and Systematic Method of Inventing," which were widely known and favorably received. Mr. Thompson is a member of American Institute of Electrical Engineers and American Society of Mechanical Engineers. He is author of the "Expansion of Polynomials," which the ablest mathematicians of the world universally commend." —*New York Observer.*

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NEW YORK & WASHINGTON ELECTRICAL PATENTS.

FOWLER & FOWLER.

A. C. FOWLER, C. E., Attorney at Law, EXAMINER IN U. S. PATENT OFFICE, 1880 to 1886, ELECTRICAL DIVISION. Office, Temple Court (Beekman and Nassau Streets), New York City.

CHAS. D. FOWLER, Counselor at Law. Office, Pacific Building (622-4 F Street, half block east Patent Office), Washington, D. C.

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Fig.259

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Fig.255

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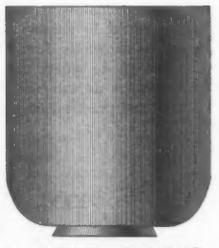

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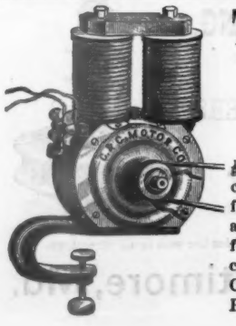

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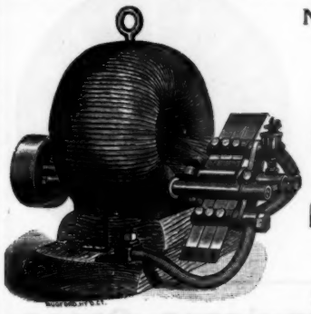

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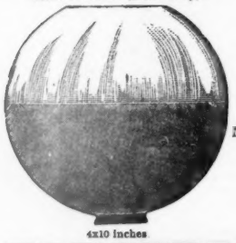

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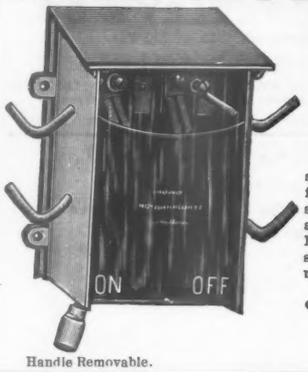

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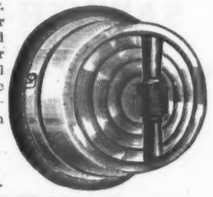

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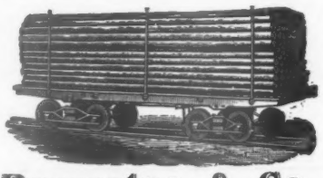

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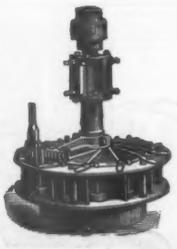

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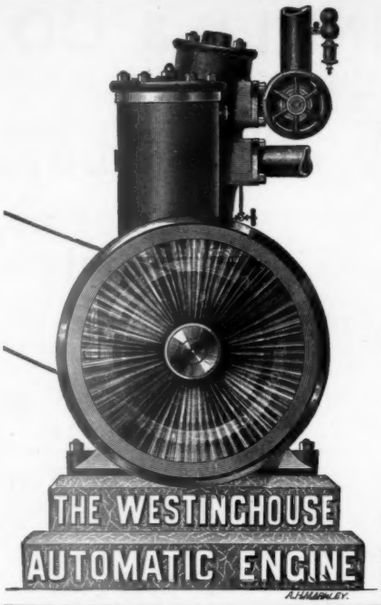

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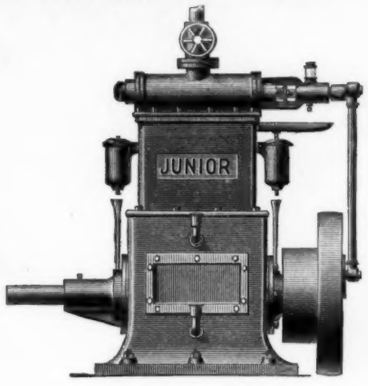

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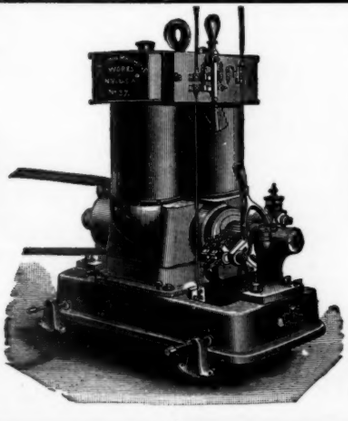

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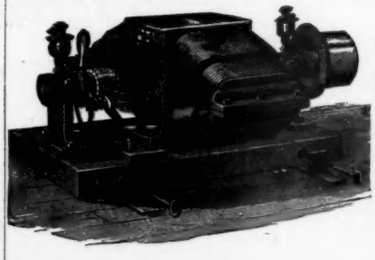

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Particulars may be learned of the undersigned, or of William C. Witter, Esq., or William H. Kenyon, Esq., their counsel, 32 Park Place, New York.

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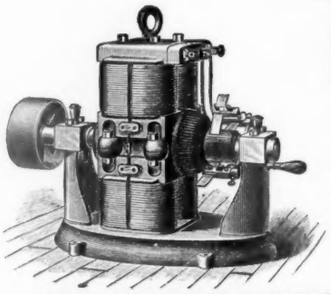
—OF—
ARC LIGHTING



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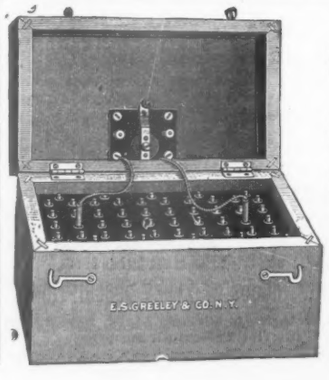

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The Edison Electric Light Company having instituted suits on its patents, must decline to substitute the advertising columns of the press for the courts for the purpose of their legal interpretation. Mr. Edison's Carbon filament patent of 1879 covers broadly the modern incandescent lamp. The claim that this patent has ever been in litigation in the United States Patent Office is absolutely false. In Germany and England this fundamental patent has finally prevailed against all infringers, thus establishing the fact that Mr. Edison's great invention has been nowhere anticipated. Ergo, a like result must follow in the United States. The straining and distorting of these facts, together with the violent effort to interweave with them certain minor and IRRELEVANT CASES for the purpose of fraudulently posing before the public as joint heirs with Mr. Edison in the fruits of these patent decisions, only indicate the DIRE EXTREMITY of those who are thus gradually becoming ENVIRONED by due process of law.

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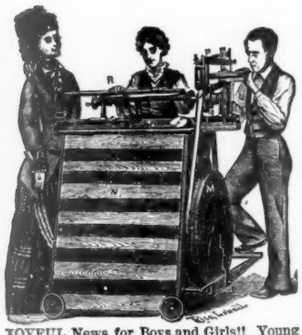

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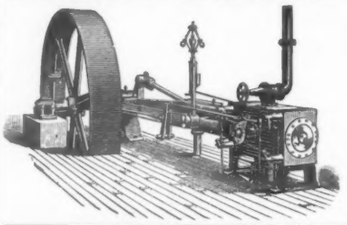

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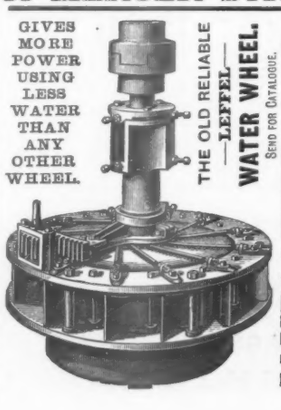

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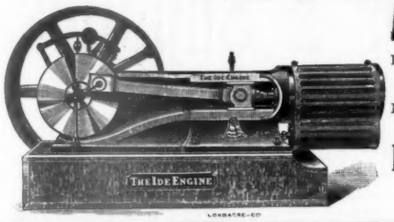

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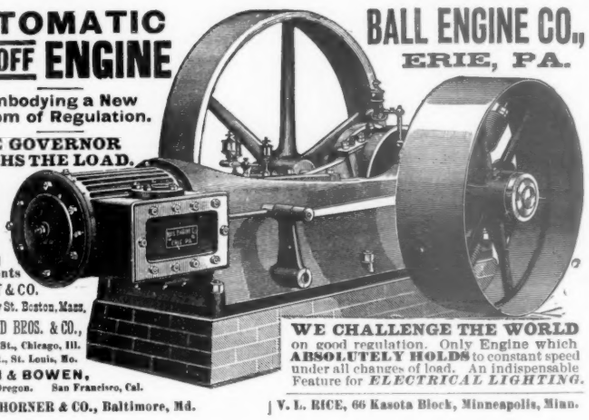

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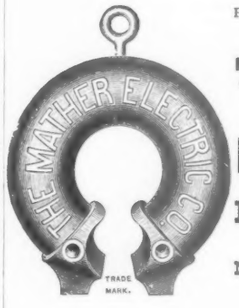

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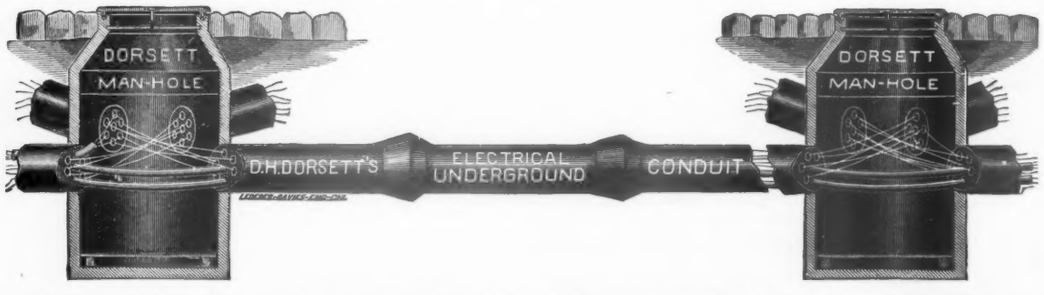

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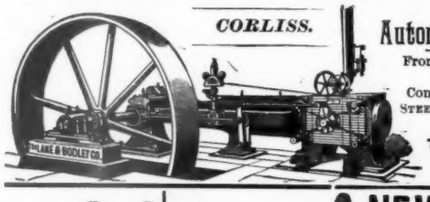

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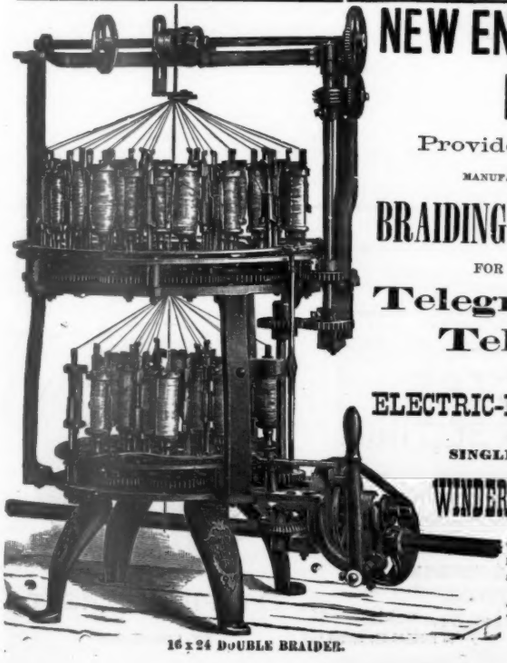

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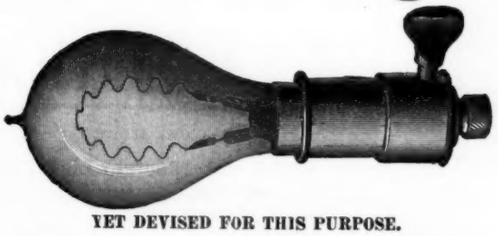

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